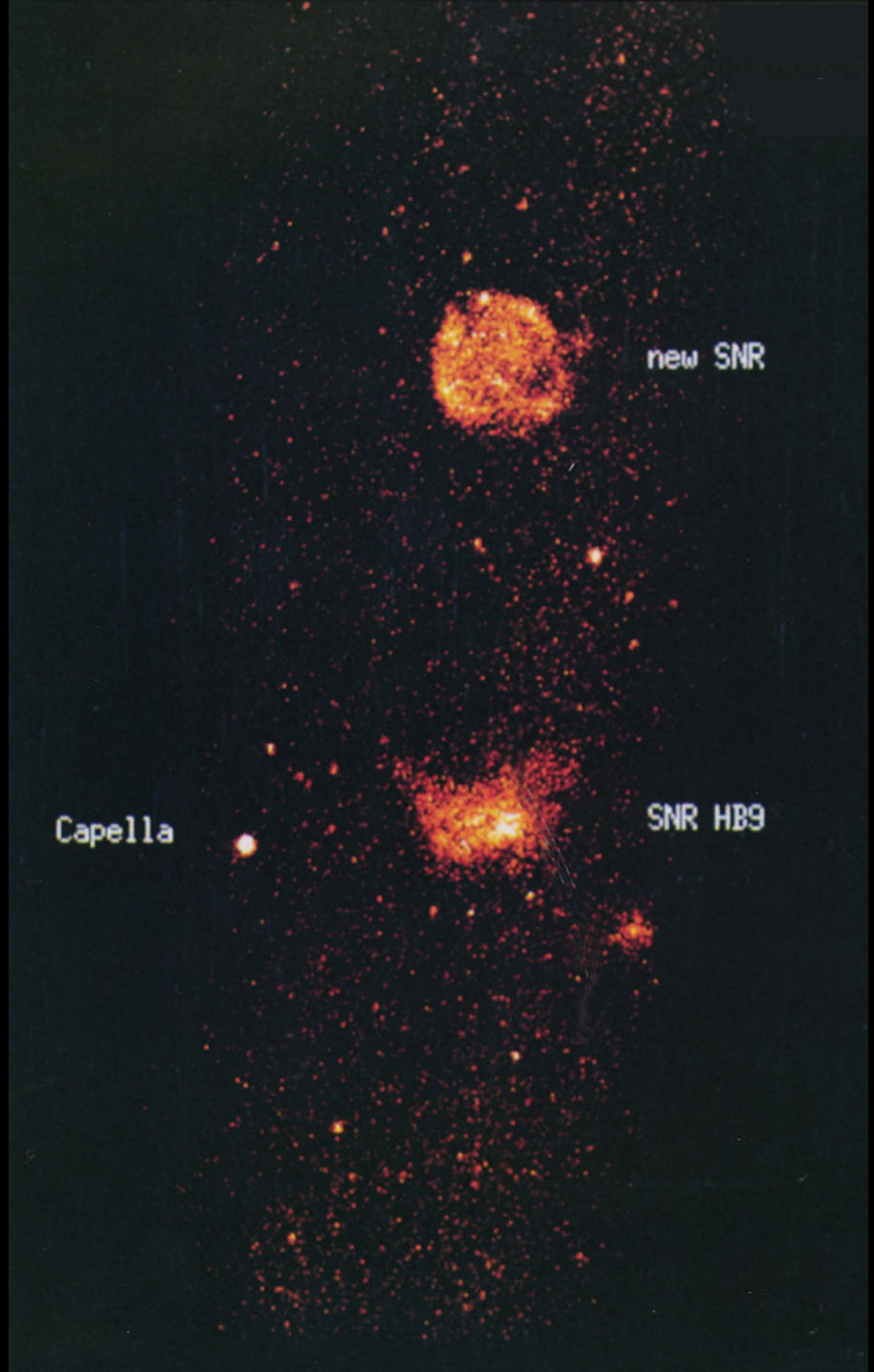
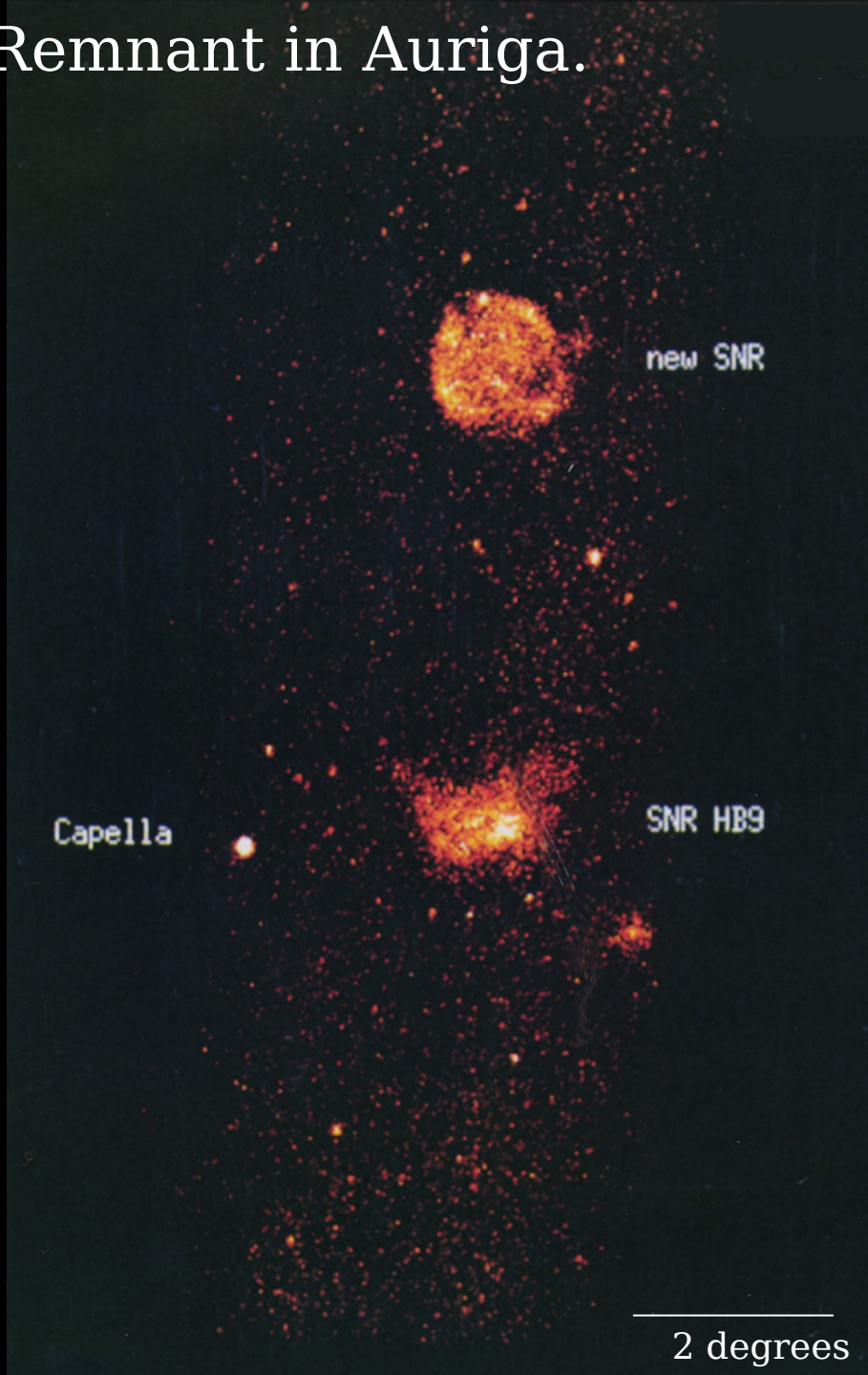
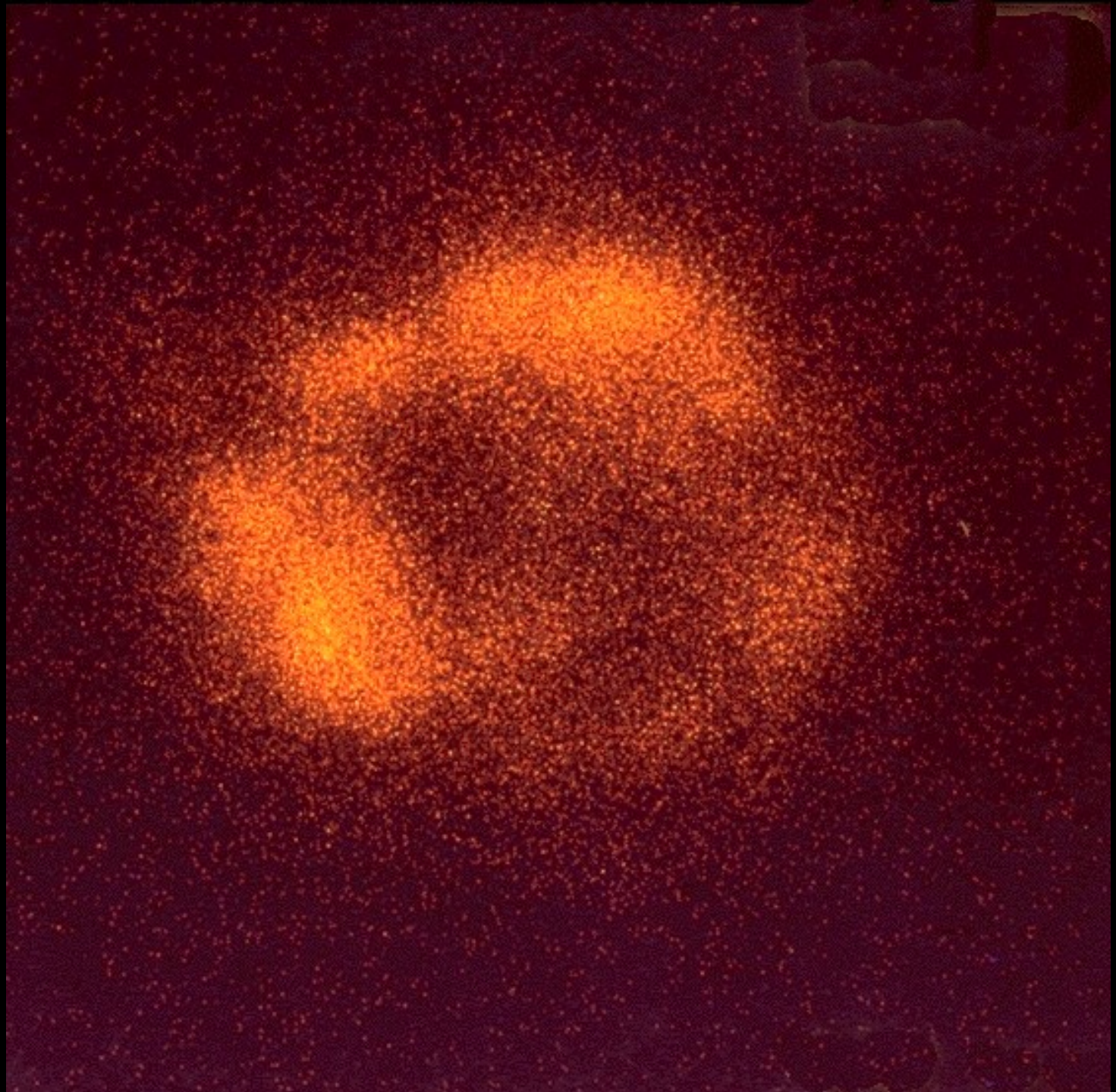

new SNR
Capella
SNR HB9

Newly Discovered Supernova Remnant in Auriga.



This X-ray image pointed towards the Auriga constellation shows a newly discovered supernova remnant, as well as the supernova remnant HB-9 and the star Capella. The extended emission to the lower right from HB-9 is a cluster of galaxies containing a thousand galaxies.

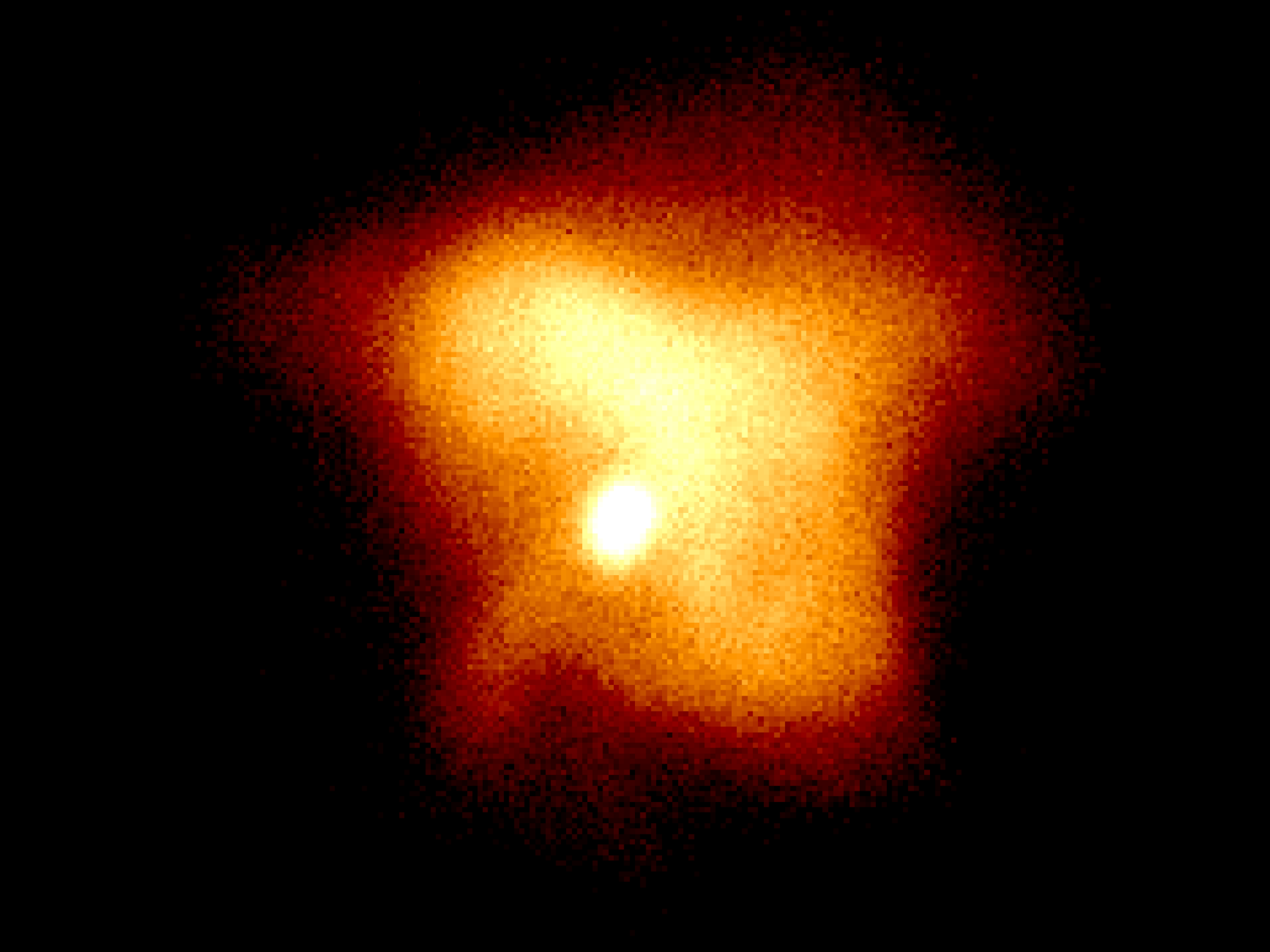
Instrument: ROSAT PSPC
Credit: MPE



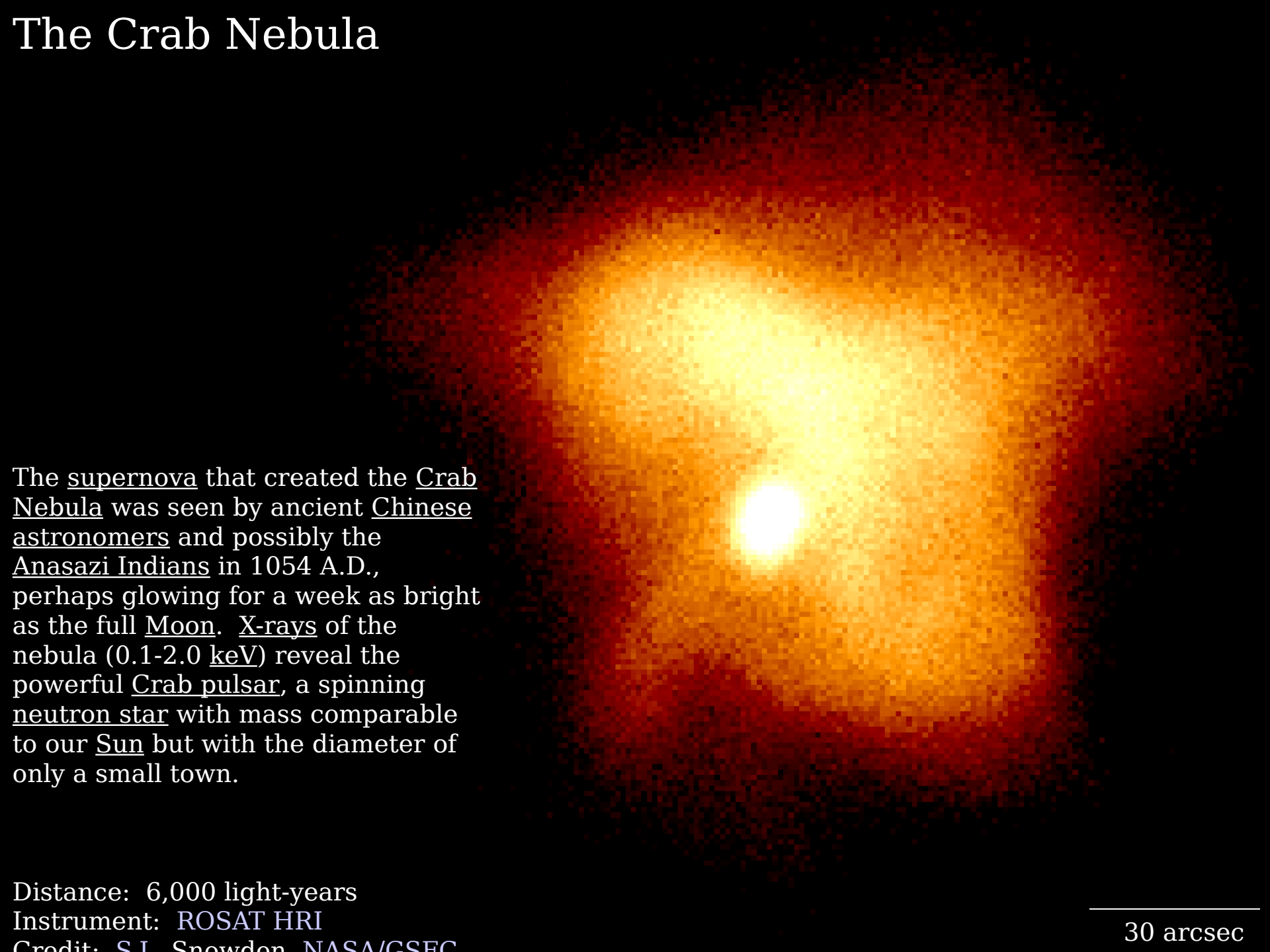
Supernova Remnant Cas-A

Supernova remnant Cas-A in the constellation of Cassiopeia was produced by an explosion 400 years ago, but it was not seen by astronomers, according to historical records. X-rays are generated in the 10 million-degree gas in the supernova shell.

Distance: 2.8 kpc
Instrument: ROSAT PSPC
Credit: MPE



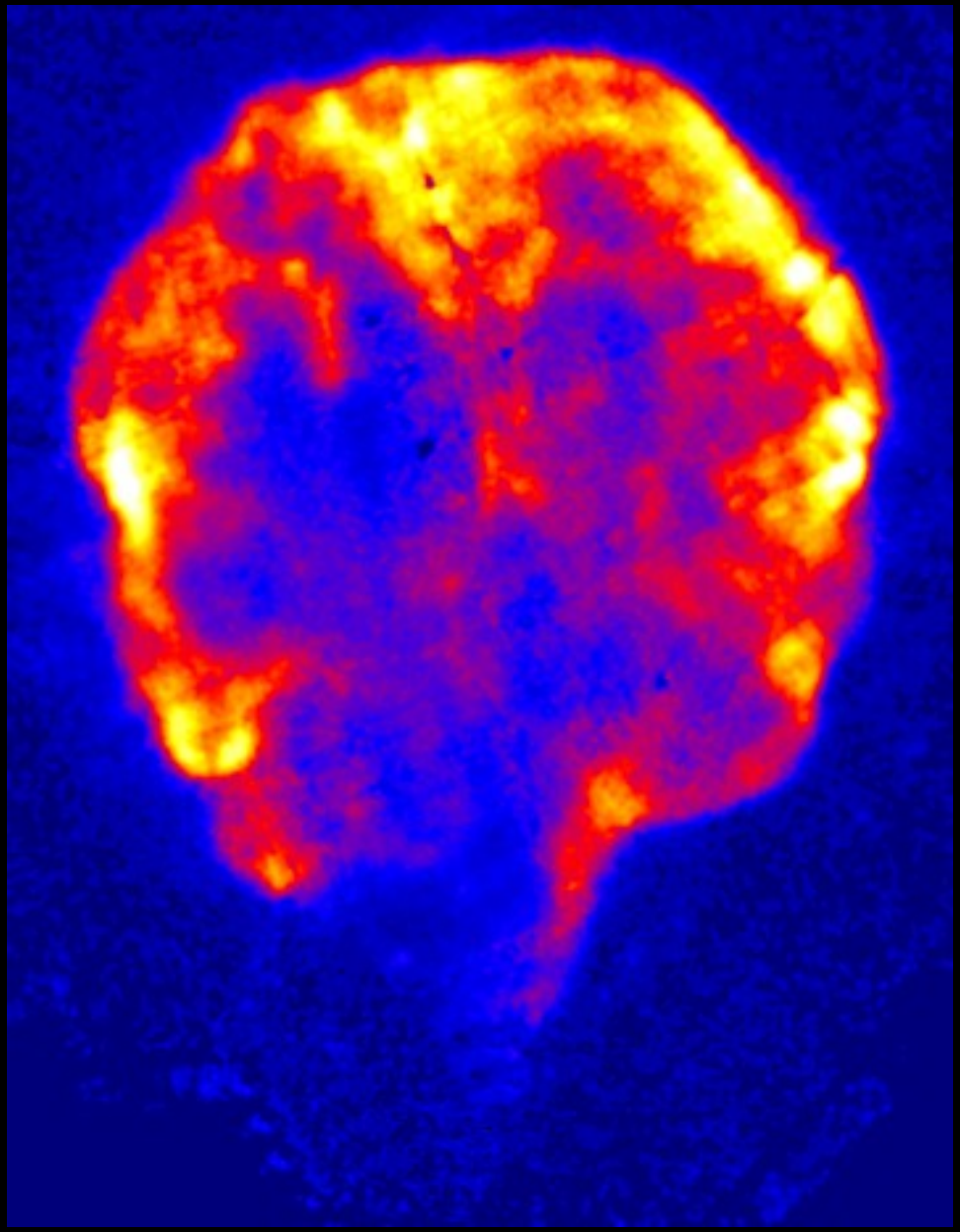
The Crab Nebula



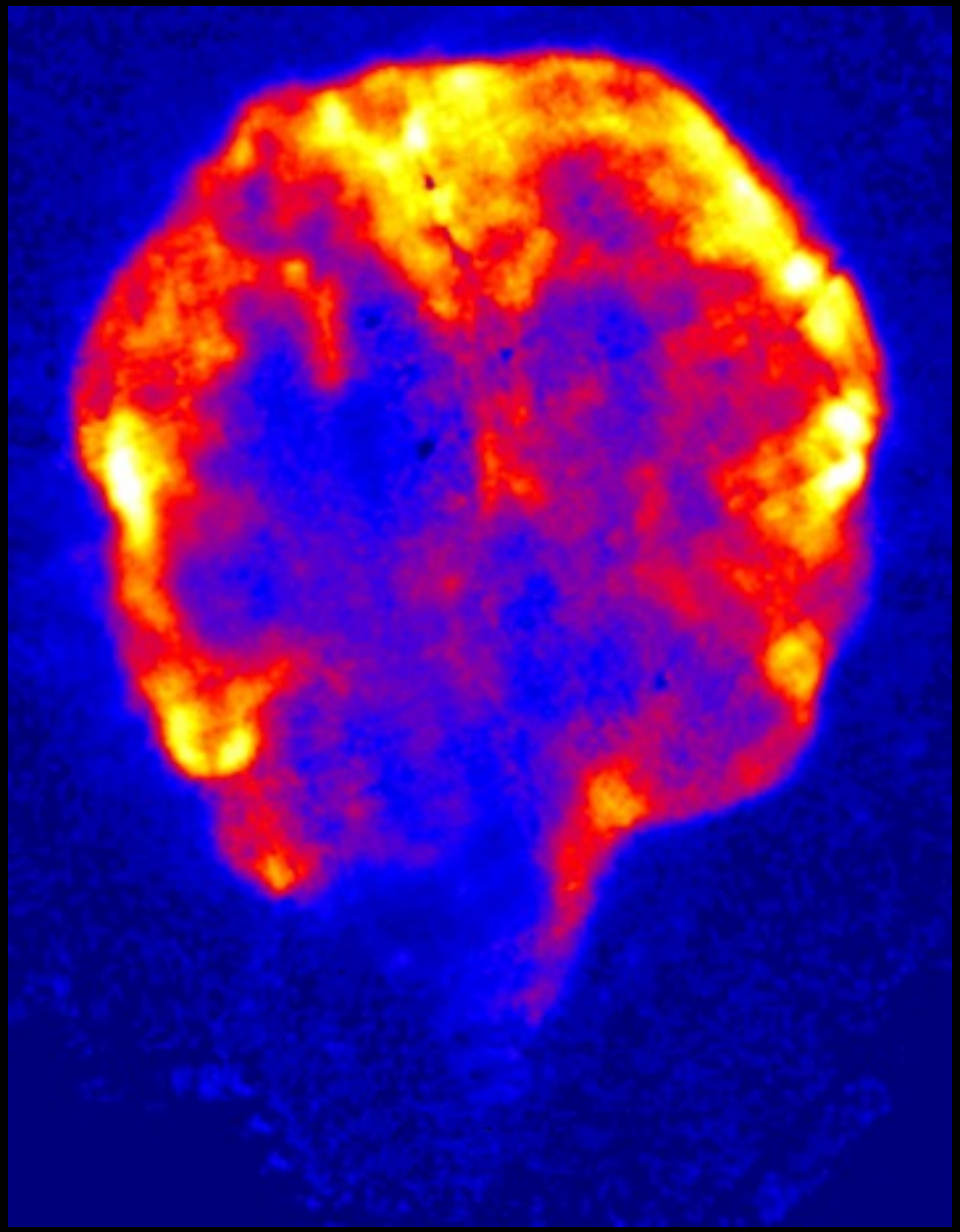
The supernova that created the Crab Nebula was seen by ancient Chinese astronomers and possibly the Anasazi Indians in 1054 A.D., perhaps glowing for a week as bright as the full Moon. X-rays of the nebula (0.1-2.0 keV) reveal the powerful Crab pulsar, a spinning neutron star with mass comparable to our Sun but with the diameter of only a small town.

Distance: 6,000 light-years
Instrument: ROSAT HRI
Credit: S.L. Snowden, NASA/GSFC

30 arcsec

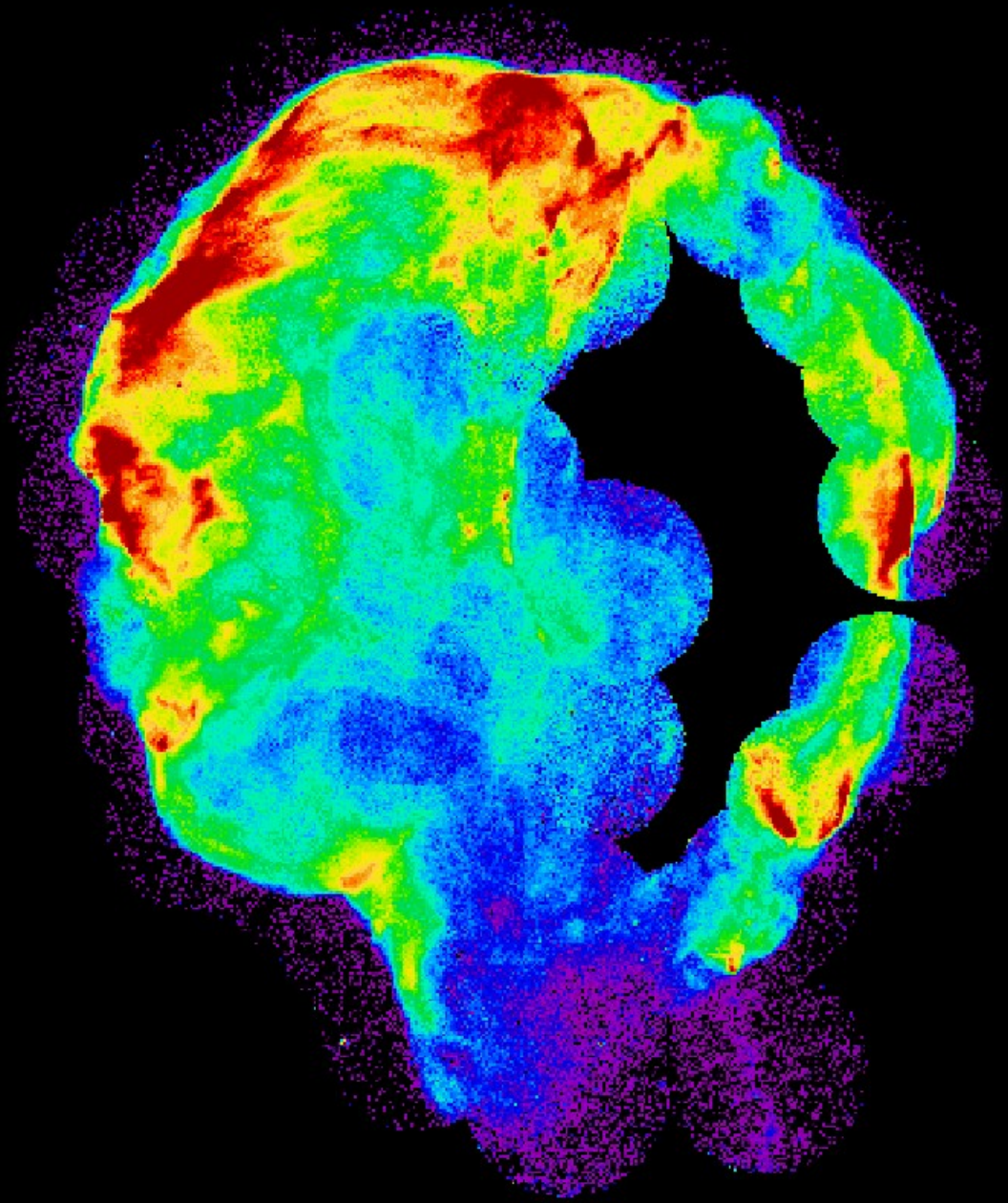


The Cygnus Loop

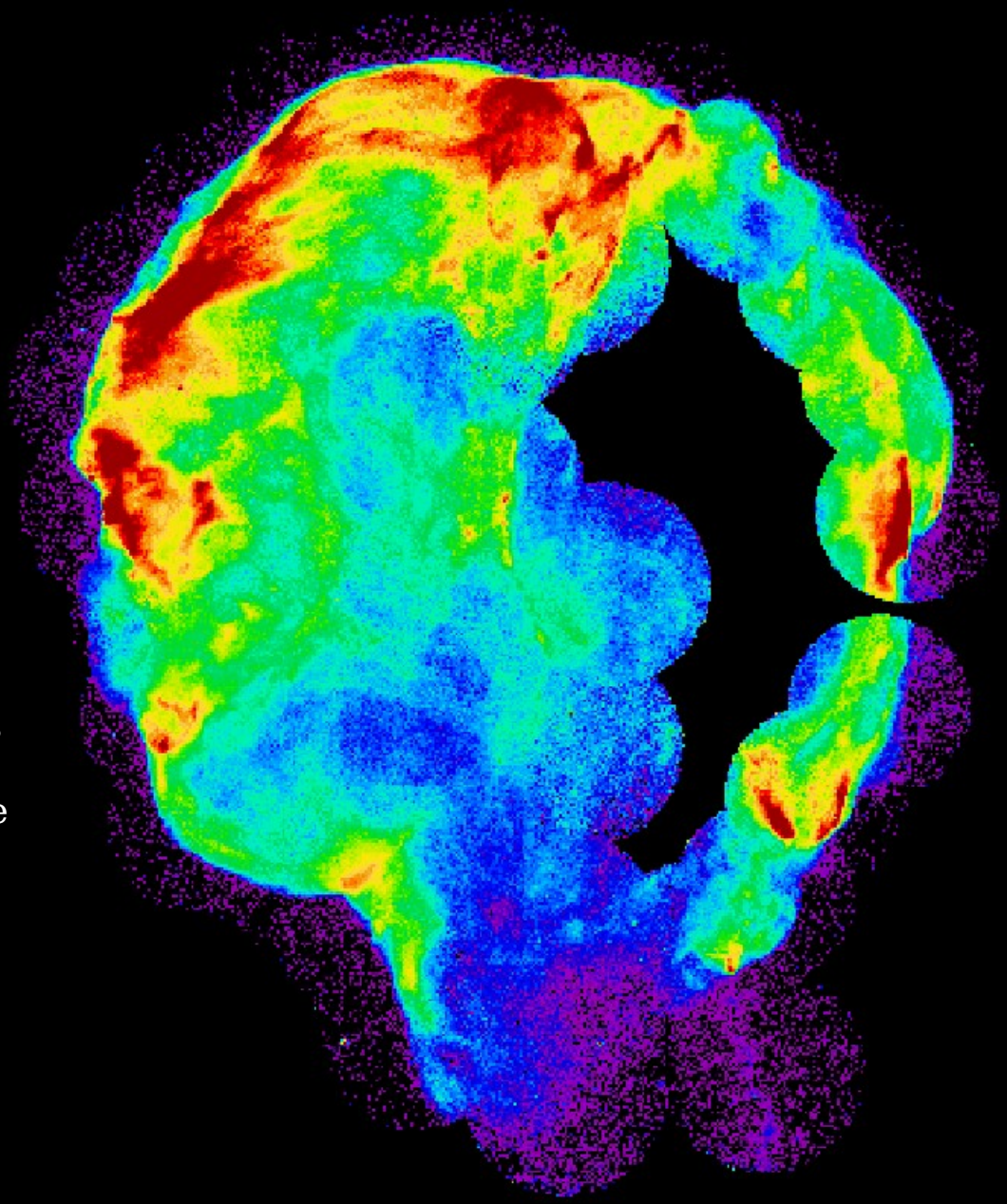


The Cygnus Loop supernova remnant in the constellation Cygnus is roughly 20,000 years old. It contains many bright, filamentary structures and is generally circular in shape except for a break-out towards the south.

Distance: 2,500 light-years
Instrument:
Einstein (HEAO-2)
Credit: NASA



The Cygnus Loop



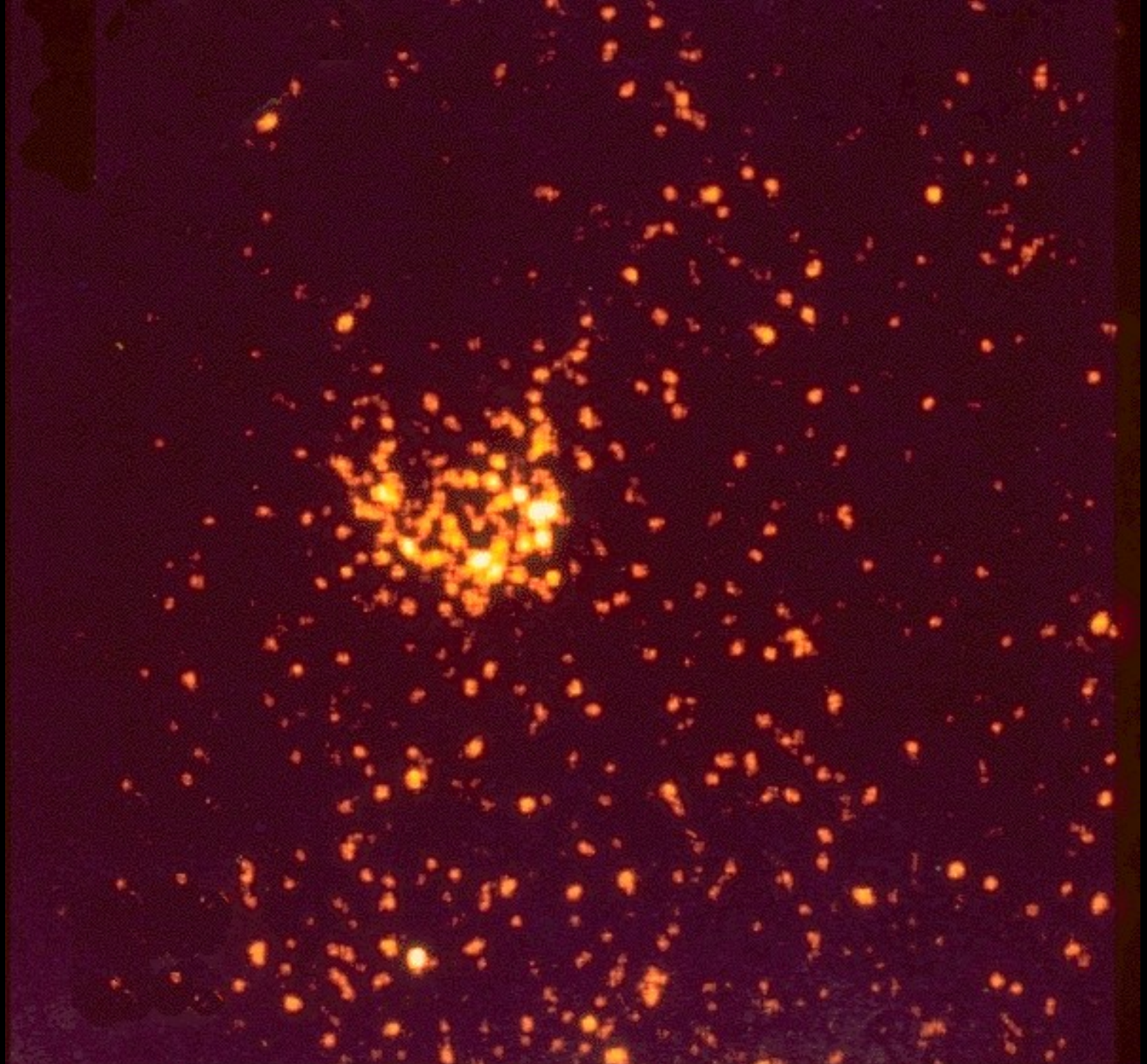
The Cygnus Loop supernova remnant in the constellation Cygnus is roughly 20,000 years old. Over 50 ROSAT pointings make up this X-ray image of the massive and generally circular remnant. The black areas represent the areas not yet sampled.

Distance: 2,500 light-years
Instrument: ROSAT HRI
Credit: Levenson et. al

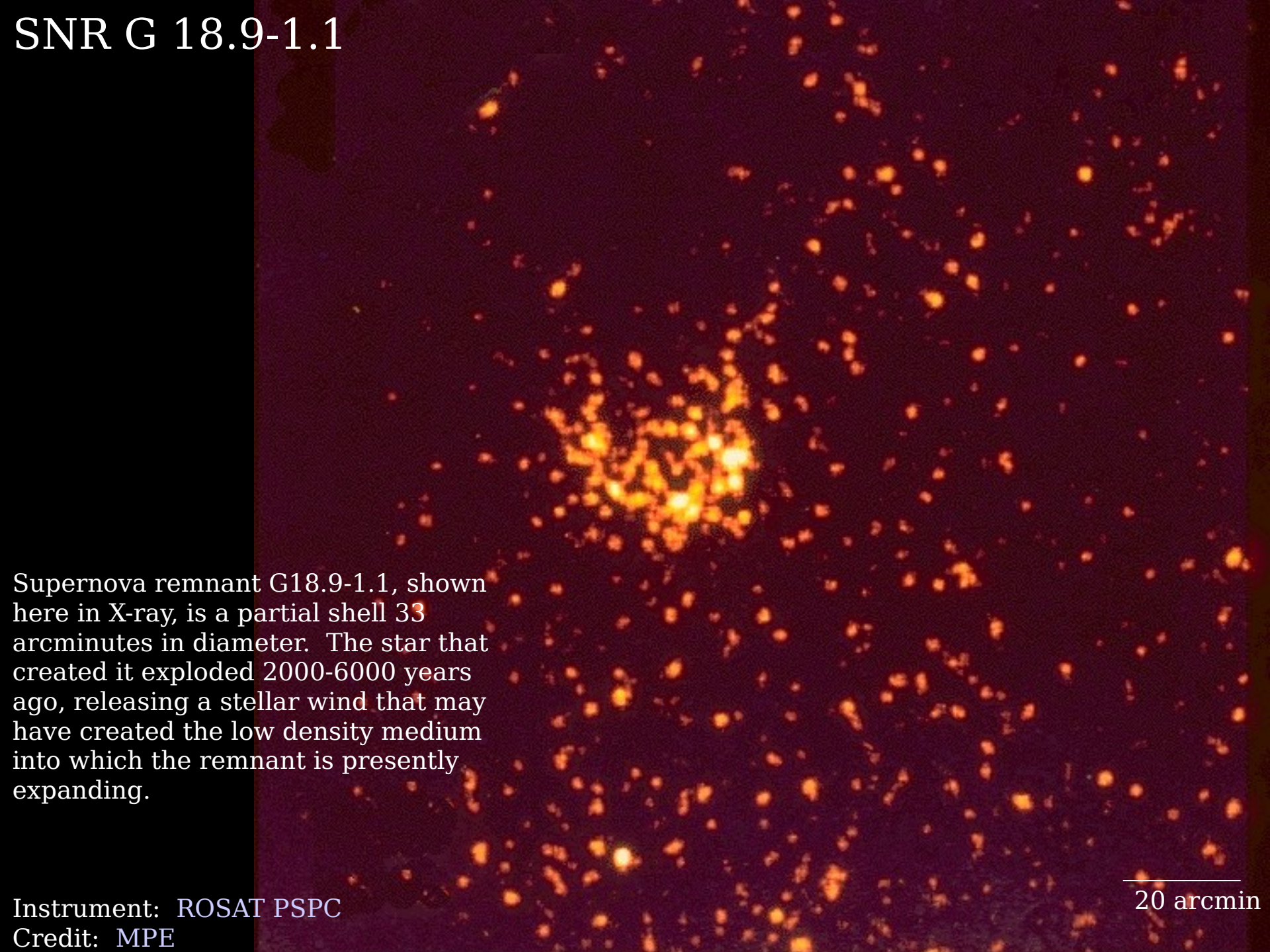
SNR G 109.1-1.0

The supernova remnant G 109.1-1.0 is about 140 light-years across; its apparent size corresponds that of the half moon. This superposition of a ROSAT X-ray image with optical photographs from the Palomar Observatory shows, in the center, the explosion remnant (bluish) of a star that lost its life about 13,000 years ago.

Distance: 15,000 light-years
Instrument: ROSAT PSPC; Palomar Observatory
Credit: K. Dennerl, MPE



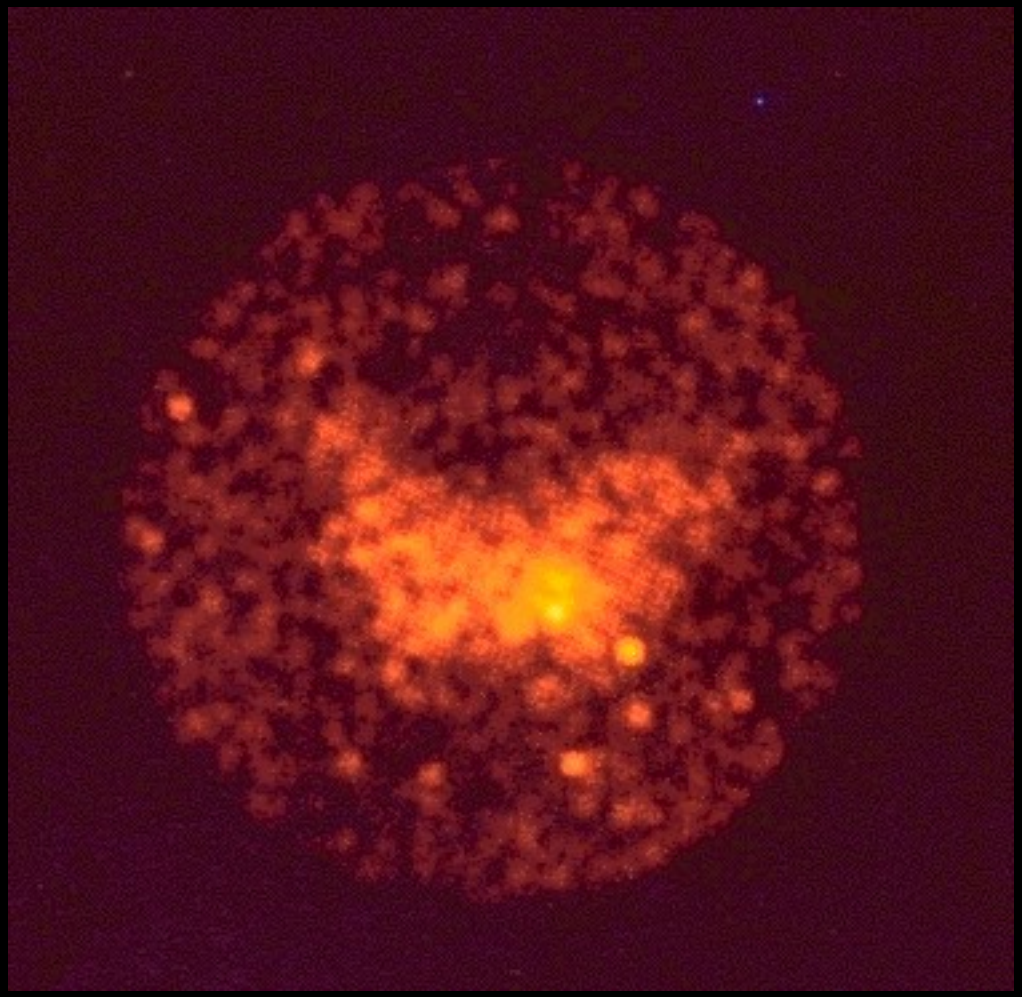
SNR G 18.9-1.1



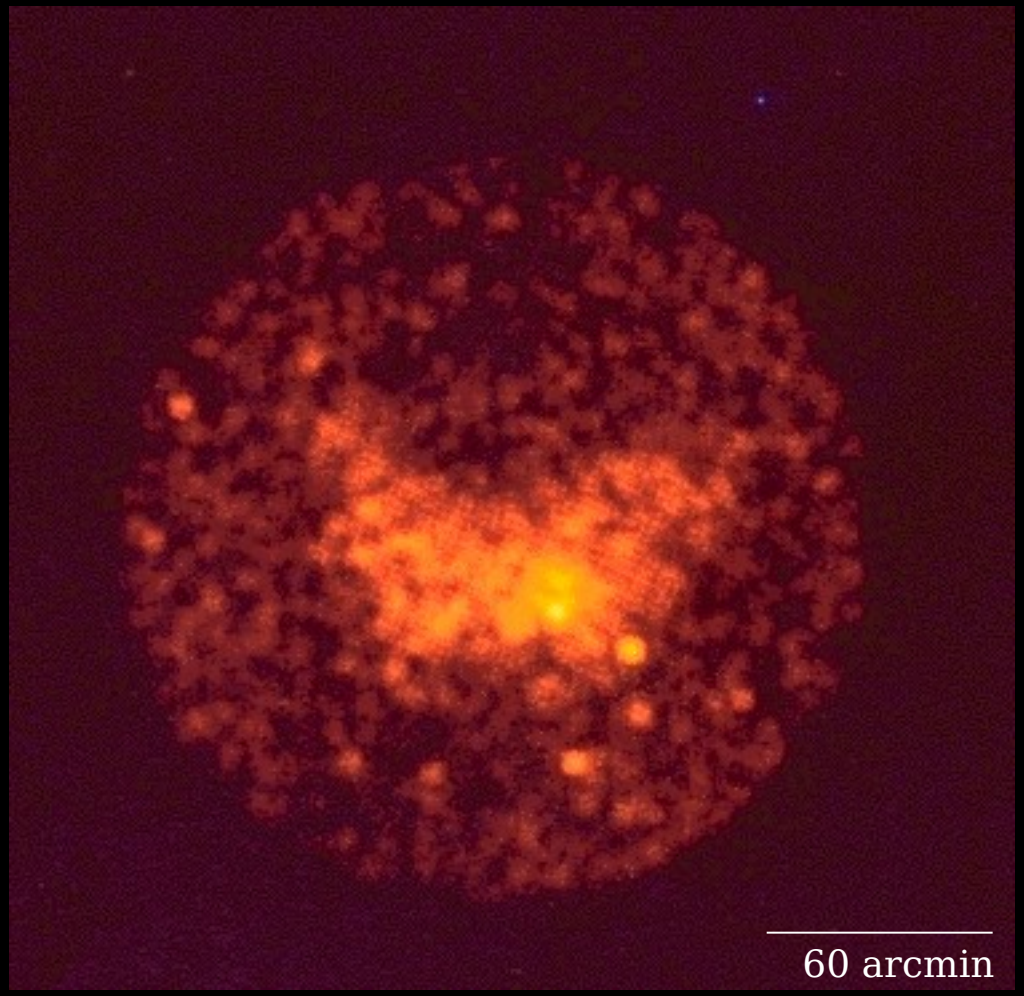
Supernova remnant G18.9-1.1, shown here in X-ray, is a partial shell 33 arcminutes in diameter. The star that created it exploded 2000-6000 years ago, releasing a stellar wind that may have created the low density medium into which the remnant is presently expanding.

20 arcmin

Instrument: ROSAT PSPC
Credit: MPE

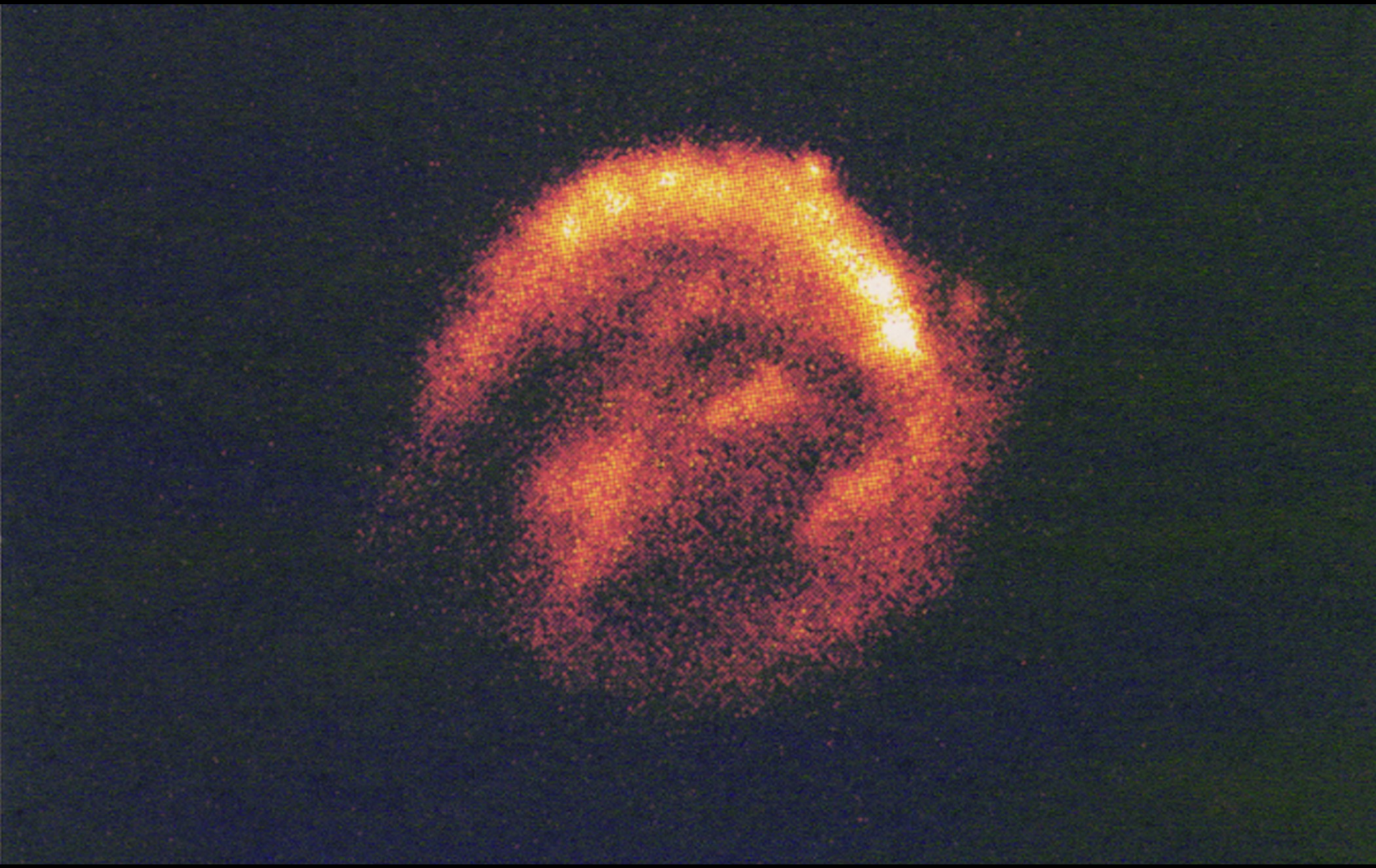


Supernova Remnant HB-9

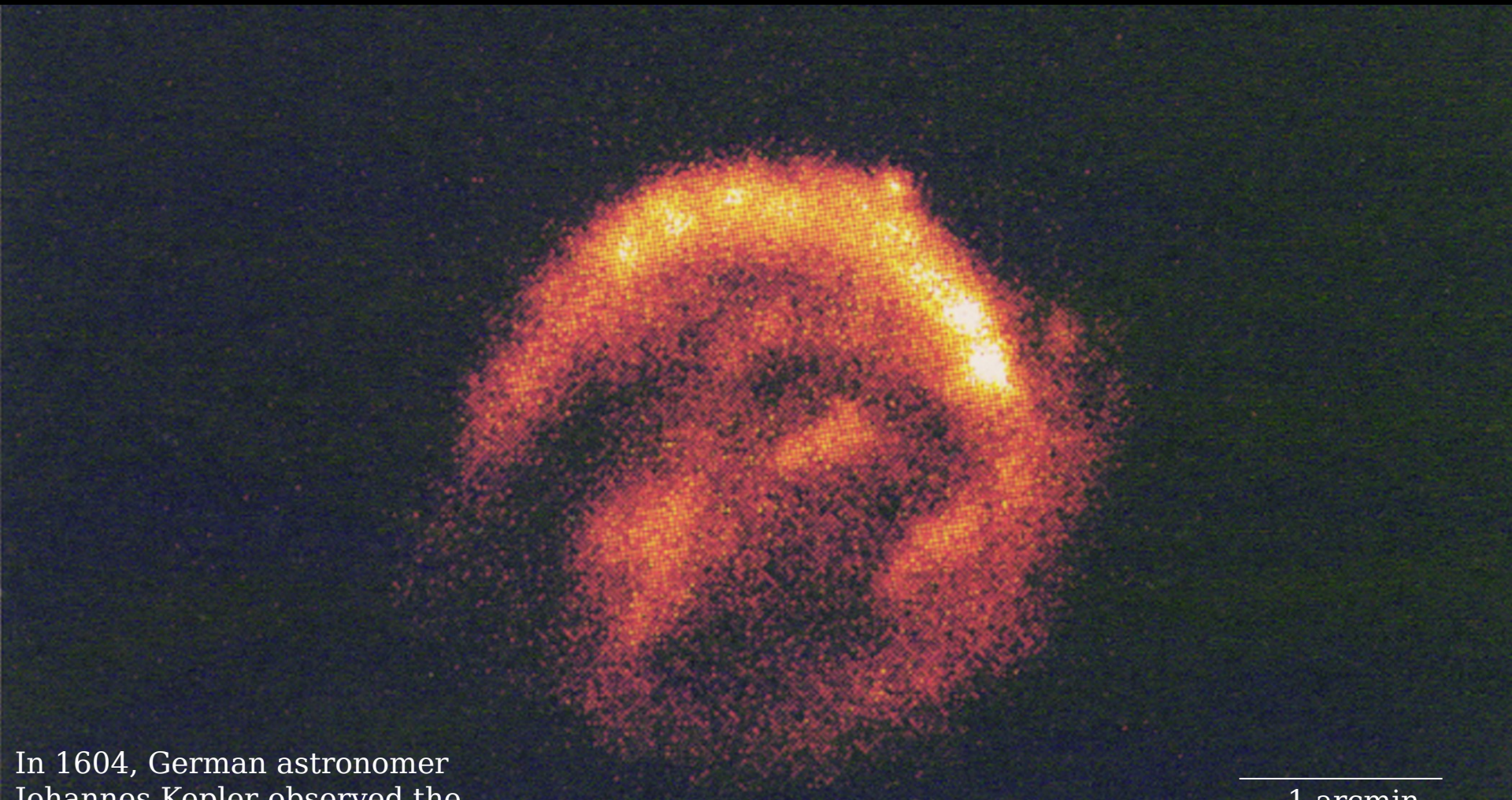


Supernova remnant HB-9, also known as G160.9+2.6, is large and evolved, with an angular diameter of 2 degrees. It has a centrally brightened morphology in X-ray, shown here, which contrasts with its shell-like appearance in the radio.

Distance: < 4kpc
Instrument: ROSAT PSPC
Credit: MPE



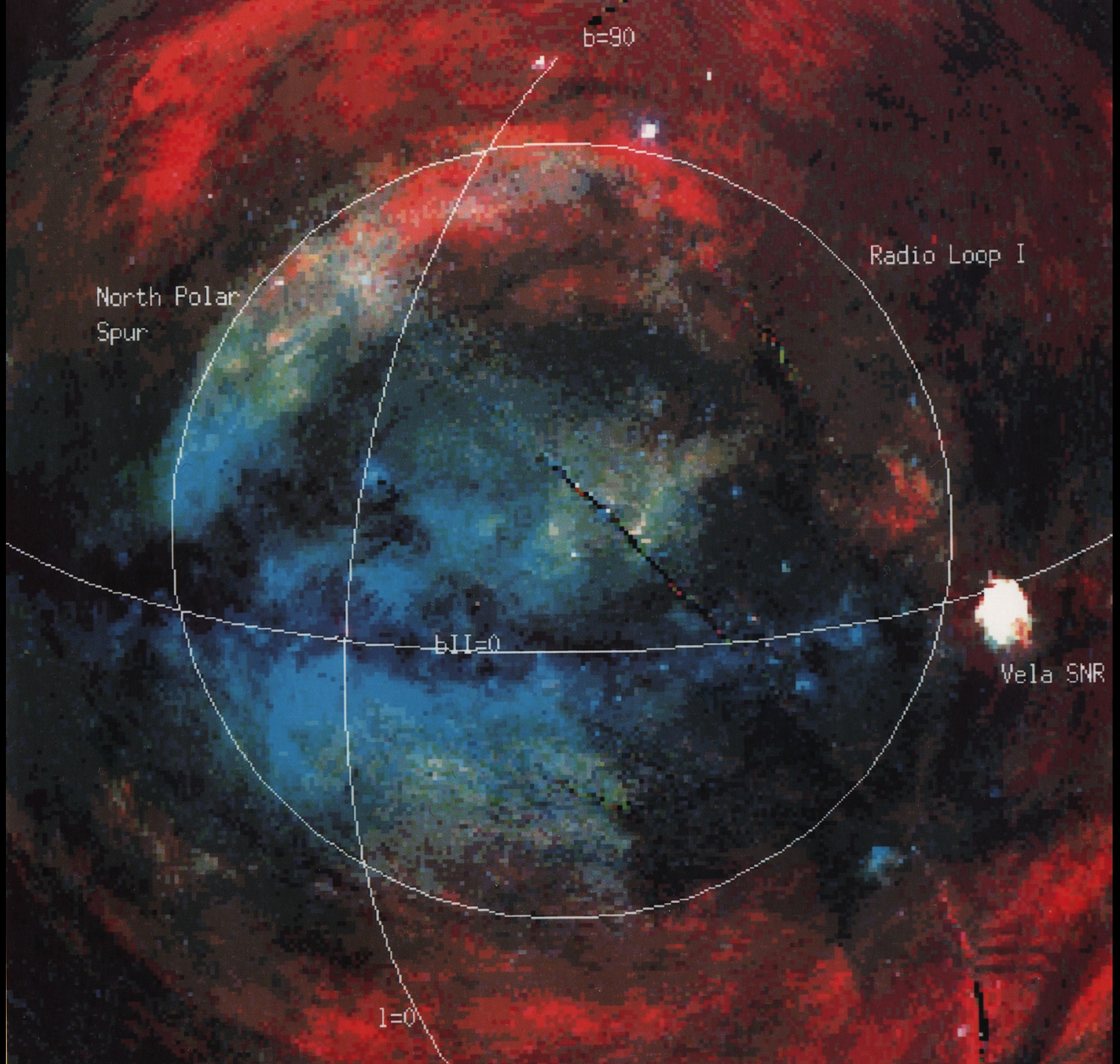
Kepler SNR 1604



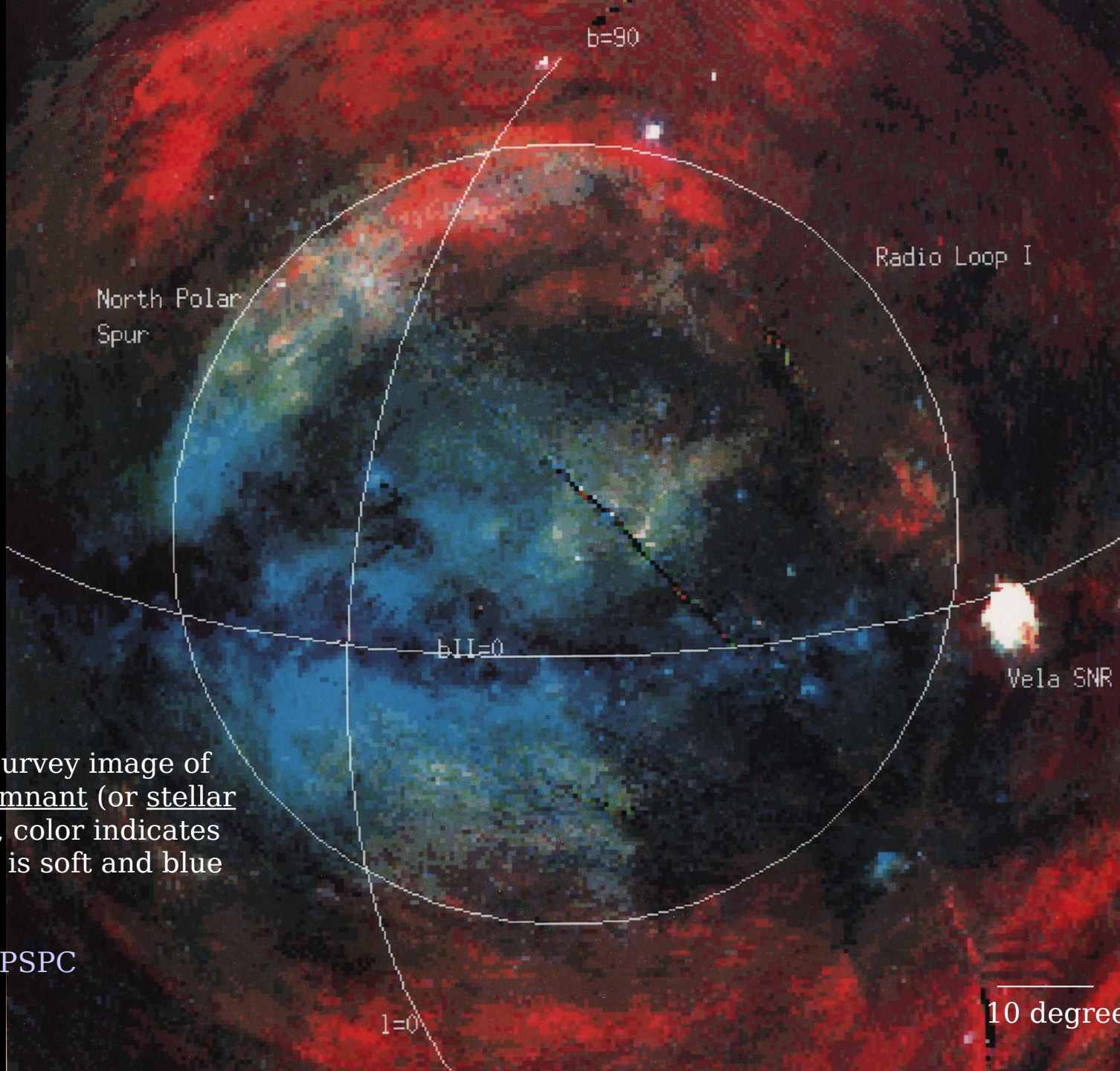
In 1604, German astronomer Johannes Kepler observed the supernova that produced this remnant, which now bears his name. The X-rays shown here are produced by the hot plasma left over from the explosion.

1 arcmin

Distance: 4.4 kpc
Instrument: ROSAT
Credit: MPE

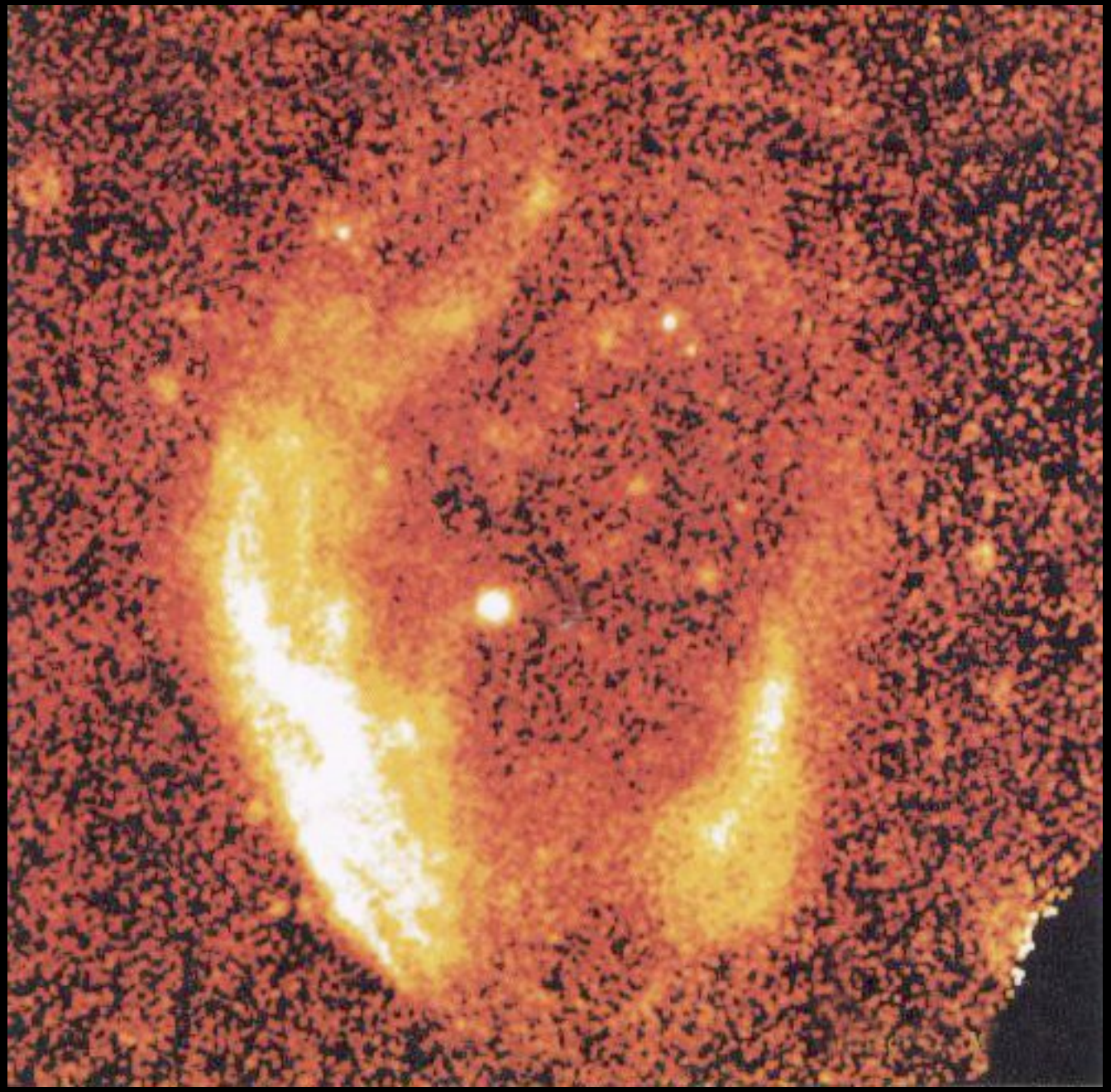

b=90
Radio Loop I
North Polar
Spur
bII=0
Vela SNR
l=0

Loop 1

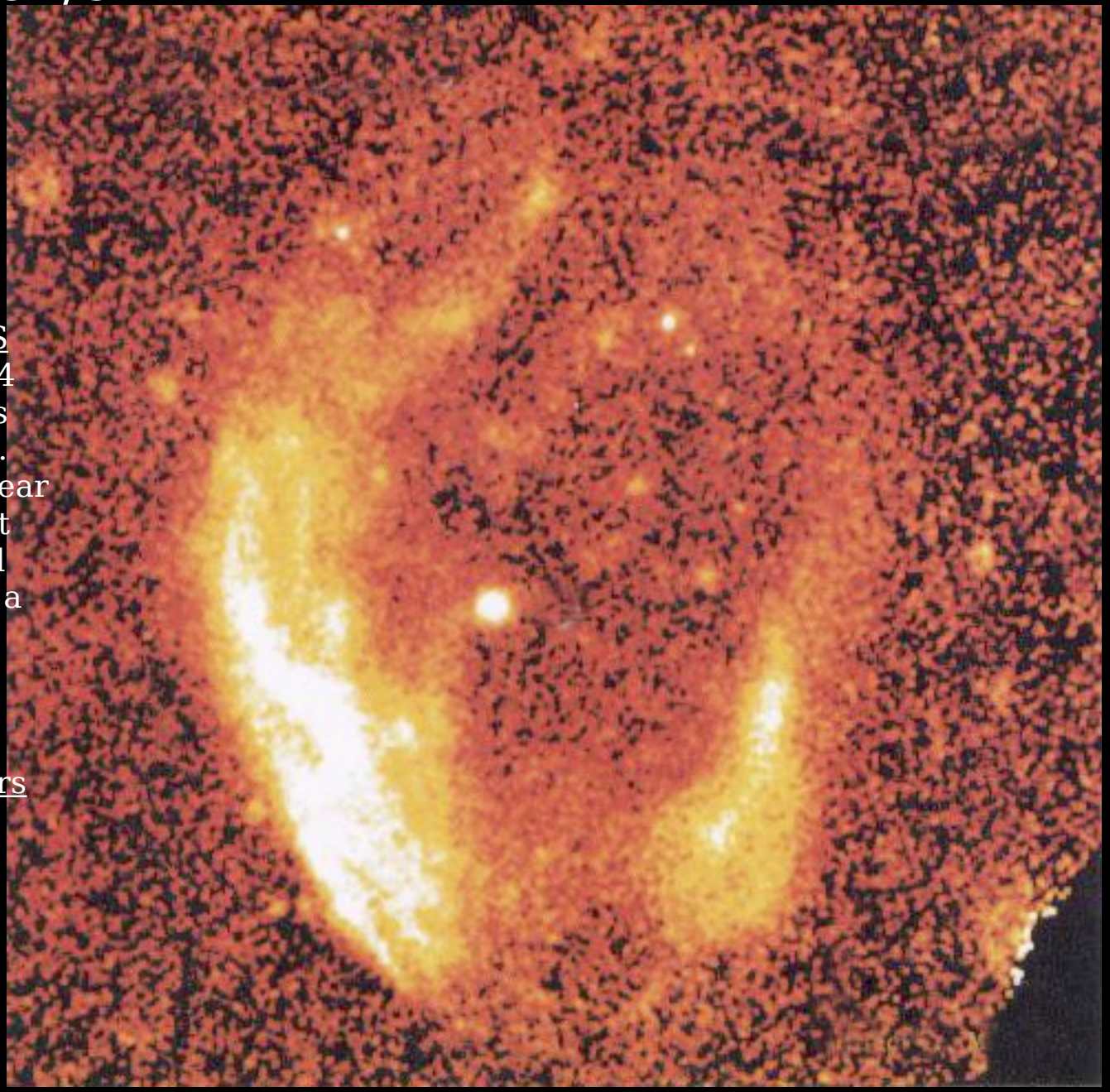


In this all-sky X-ray survey image of nearby supernova remnant (or stellar wind bubble) Loop 1, color indicates X-ray hardness: Red is soft and blue is hard.

Instrument: ROSAT PSPC
Credit: MPE



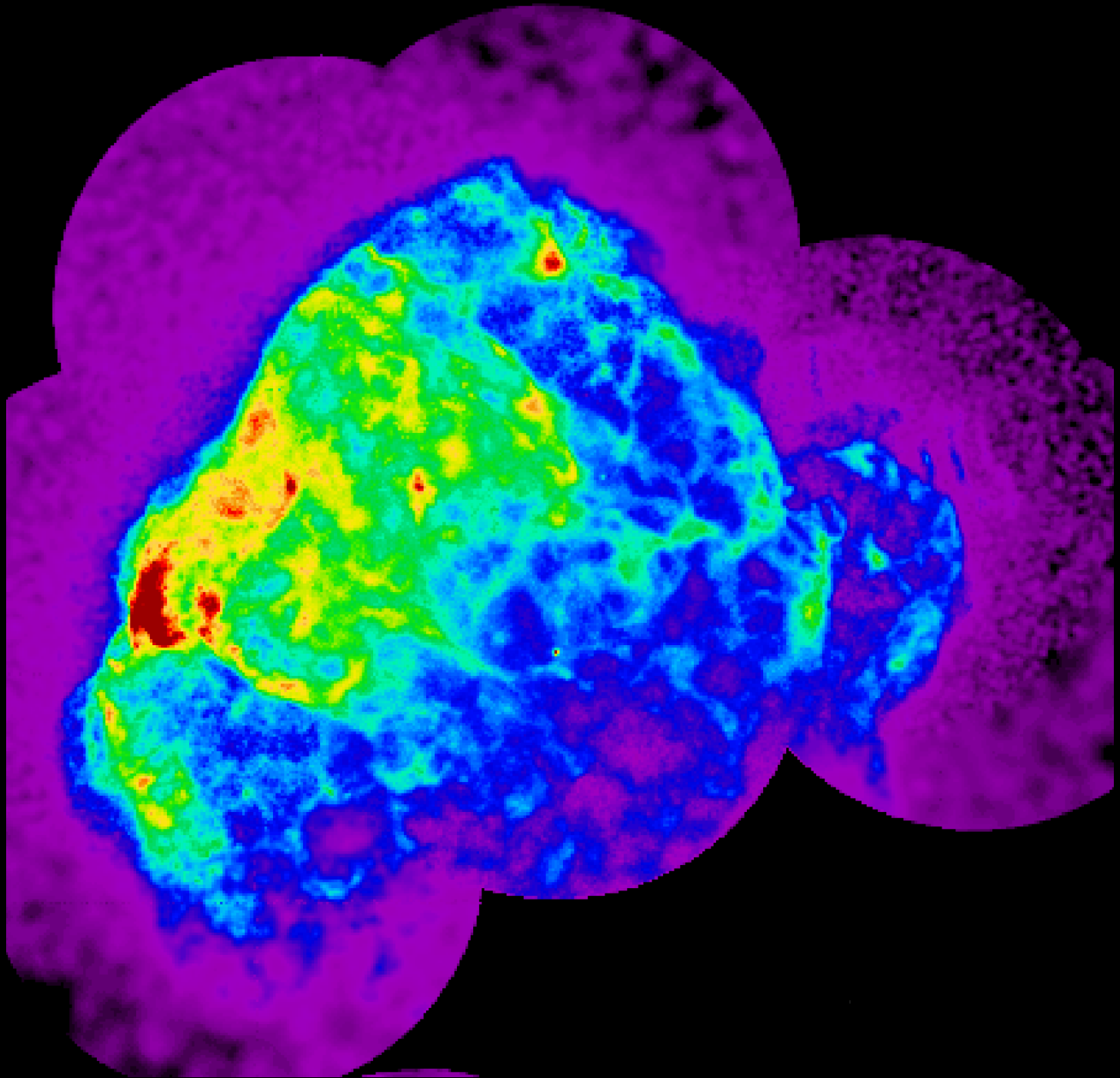
SNR PKS 1209-51/52



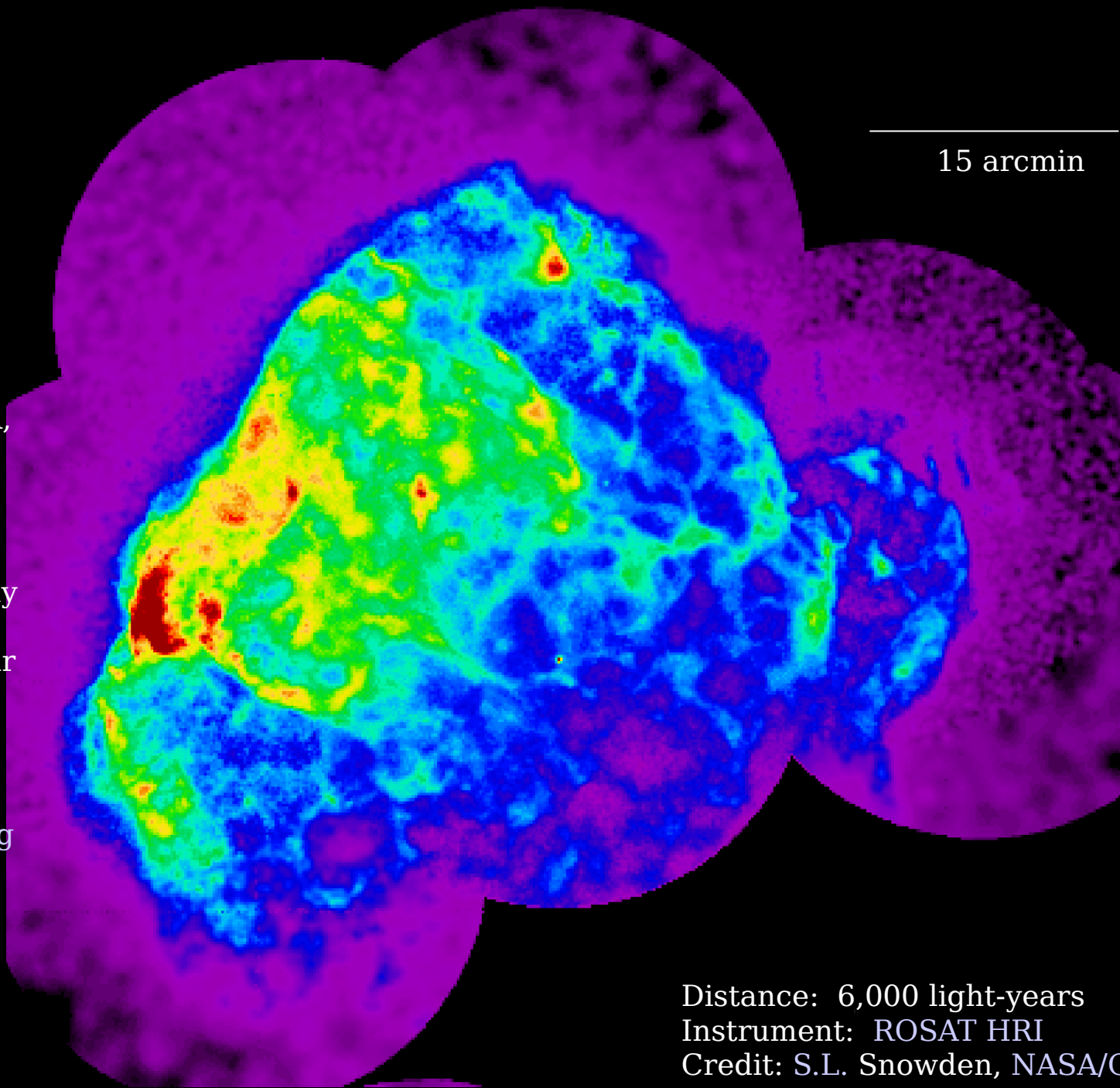
The supernova remnant PKS 1209-51/52, shown at 0.1-2.4 keV, is about 150 light-years across and 10,000 years old. The compact X-ray source near the geometric center is most likely a neutron star created by the same explosion, with a 3 million-degree surface emitting exclusively X-rays.

Distance: > 1,000 light-years
Instrument: ROSAT PSPC
Credit: H. Becker, MPE

2 arcmin

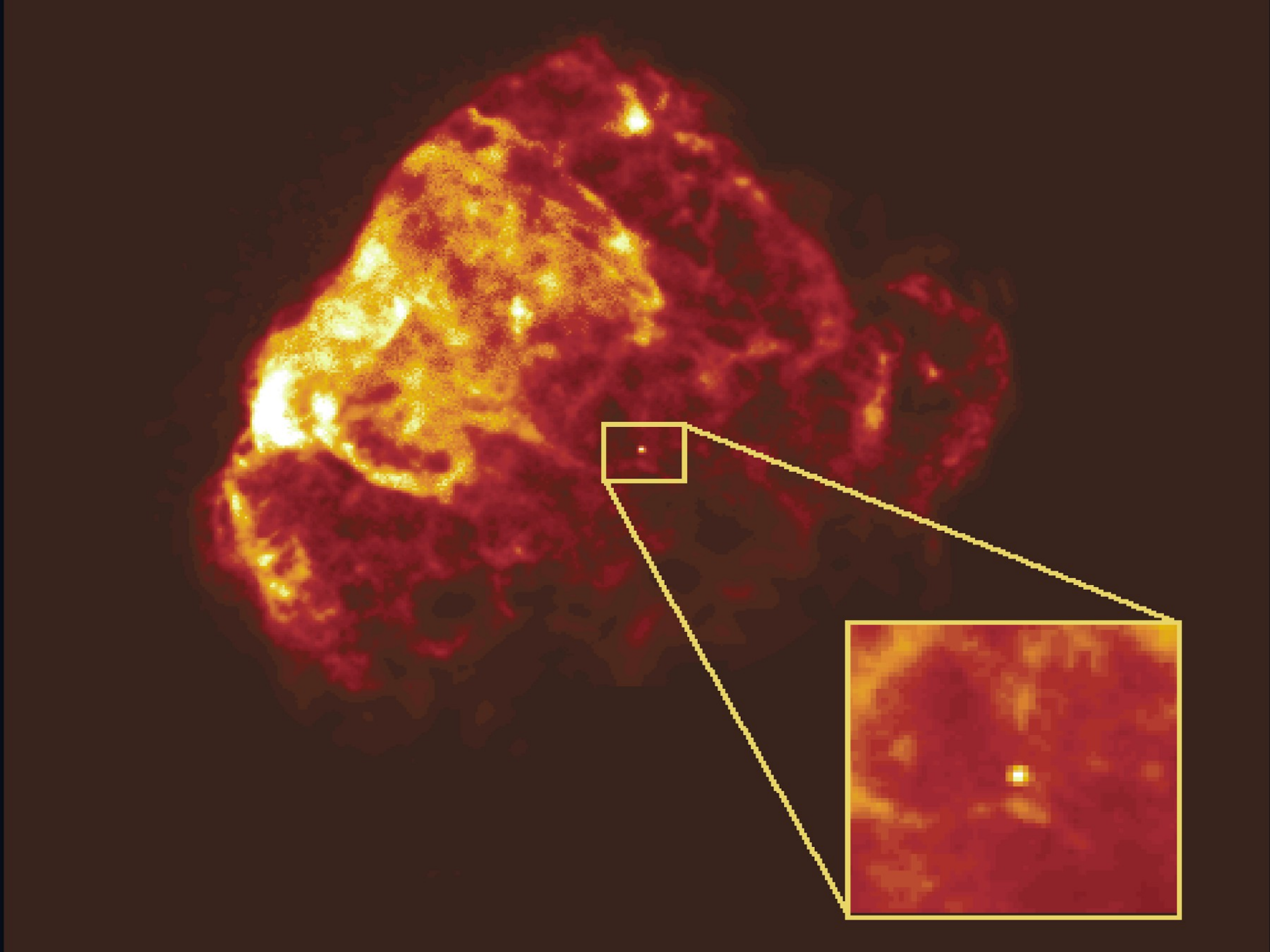


Puppis A

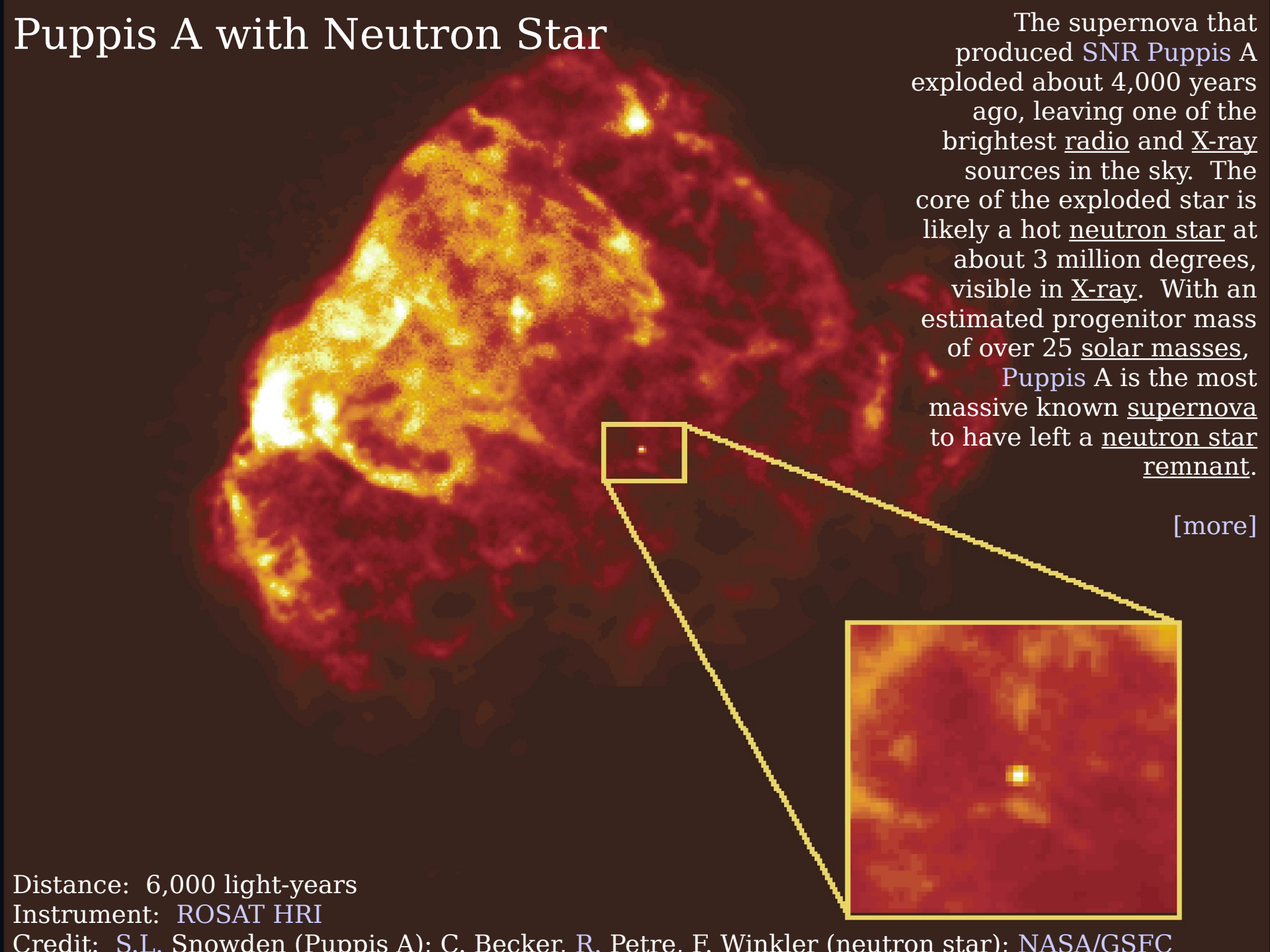


The supernova that produced SNR Puppis A, shown in X-ray energy 0.1-2.0 keV, exploded about 4,000 years ago, leaving one of the brightest radio and X-ray sources in the sky. The core of the exploded star is likely a hot neutron star about 3 million degrees, which can be seen in a second ROSAT HRI image.

Distance: 6,000 light-years
Instrument: ROSAT HRI
Credit: S.L. Snowden, NASA/G



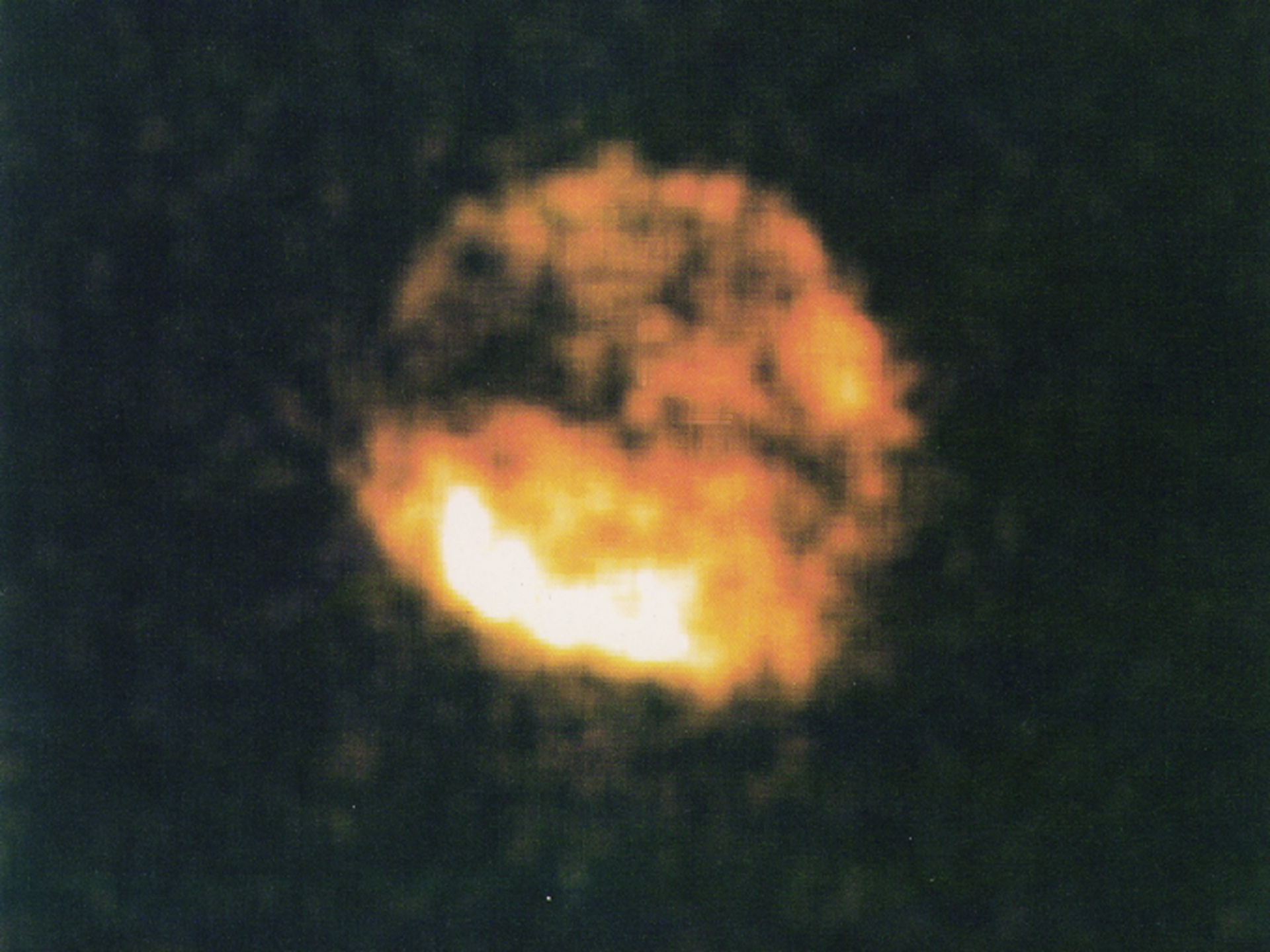
Puppis A with Neutron Star



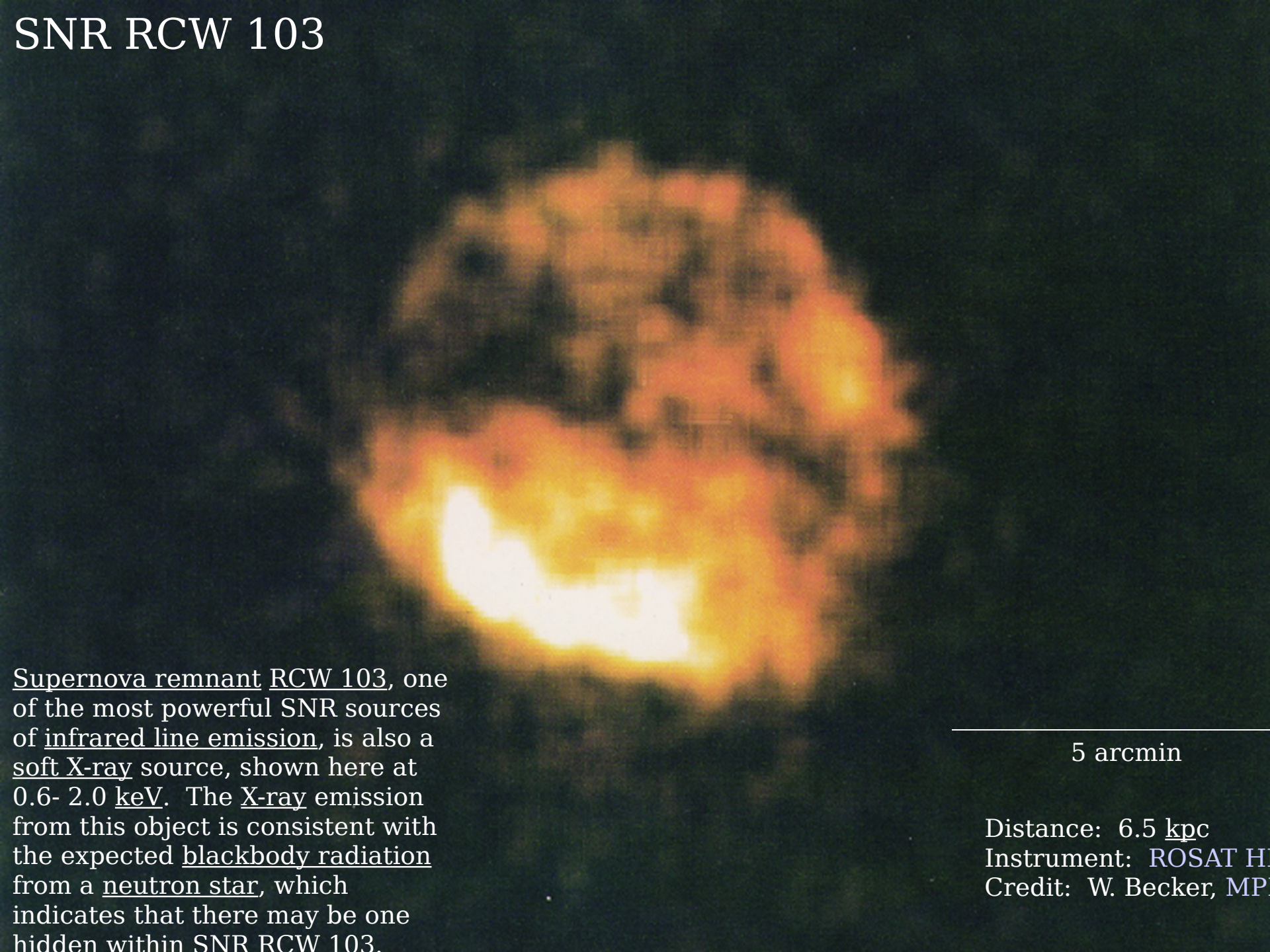
The supernova that produced SNR Puppis A exploded about 4,000 years ago, leaving one of the brightest radio and X-ray sources in the sky. The core of the exploded star is likely a hot neutron star at about 3 million degrees, visible in X-ray. With an estimated progenitor mass of over 25 solar masses, Puppis A is the most massive known supernova to have left a neutron star remnant.

[more]

Distance: 6,000 light-years
Instrument: ROSAT HRI
Credit: S.L. Snowden (Puppis A); C. Becker, R. Petre, F. Winkler (neutron star); NASA/GSFC



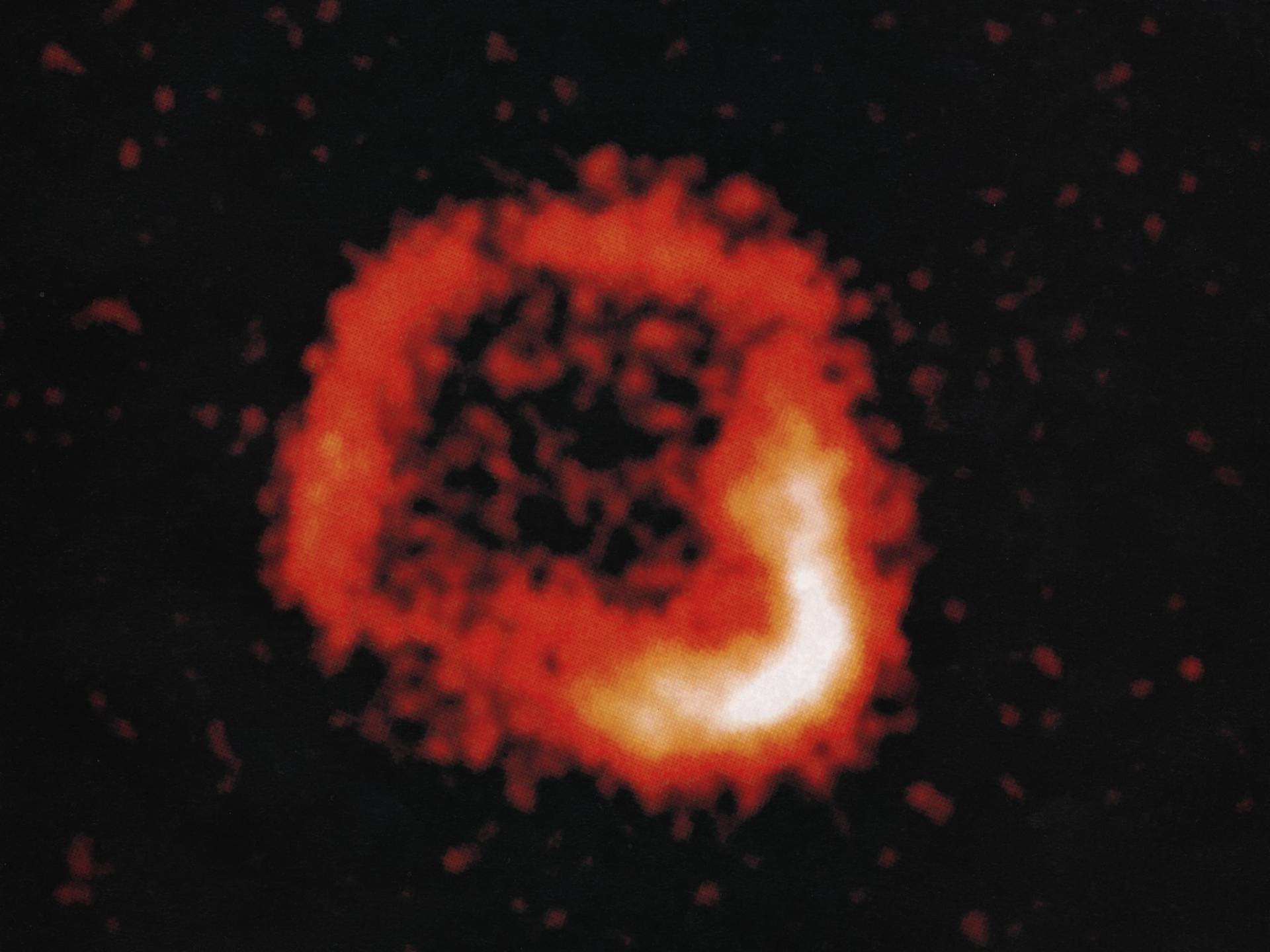
SNR RCW 103



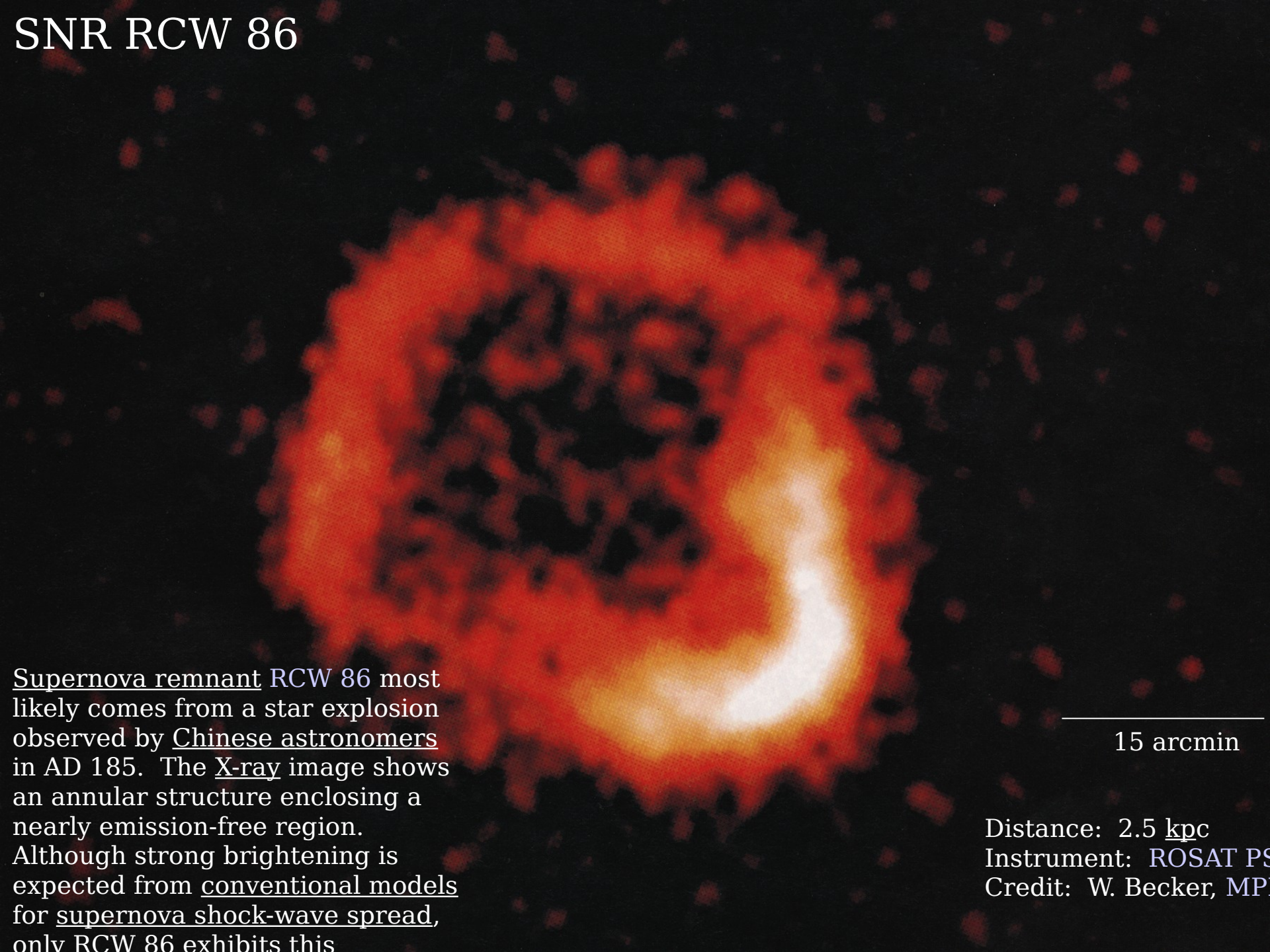
Supernova remnant RCW 103, one of the most powerful SNR sources of infrared line emission, is also a soft X-ray source, shown here at 0.6- 2.0 keV. The X-ray emission from this object is consistent with the expected blackbody radiation from a neutron star, which indicates that there may be one hidden within SNR RCW 103.

5 arcmin

Distance: 6.5 kpc
Instrument: ROSAT HI
Credit: W. Becker, MPI



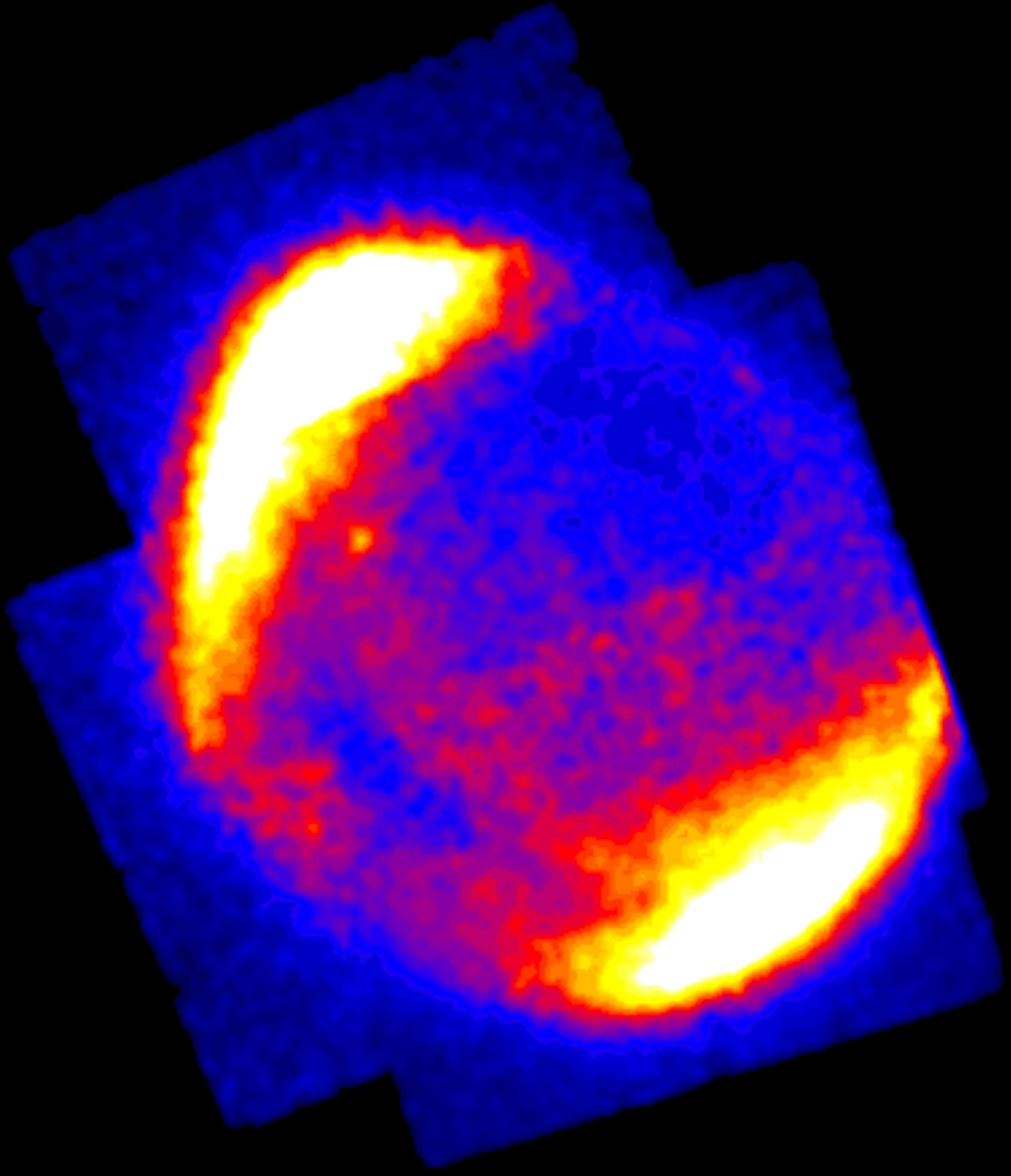
SNR RCW 86



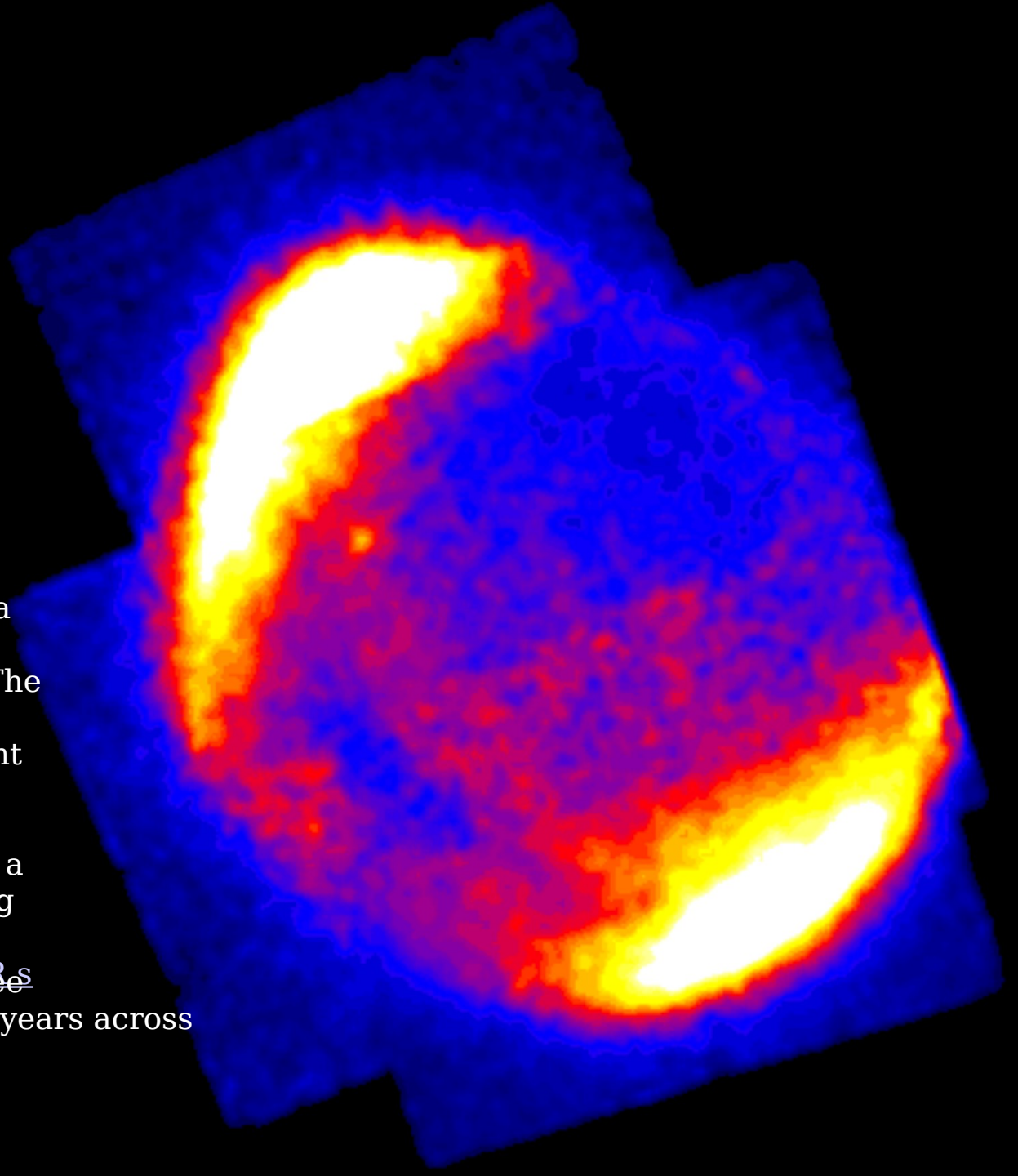
Supernova remnant RCW 86 most likely comes from a star explosion observed by Chinese astronomers in AD 185. The X-ray image shows an annular structure enclosing a nearly emission-free region. Although strong brightening is expected from conventional models for supernova shock-wave spread, only RCW 86 exhibits this

15 arcmin

Distance: 2.5 kpc
Instrument: ROSAT PS
Credit: W. Becker, MP

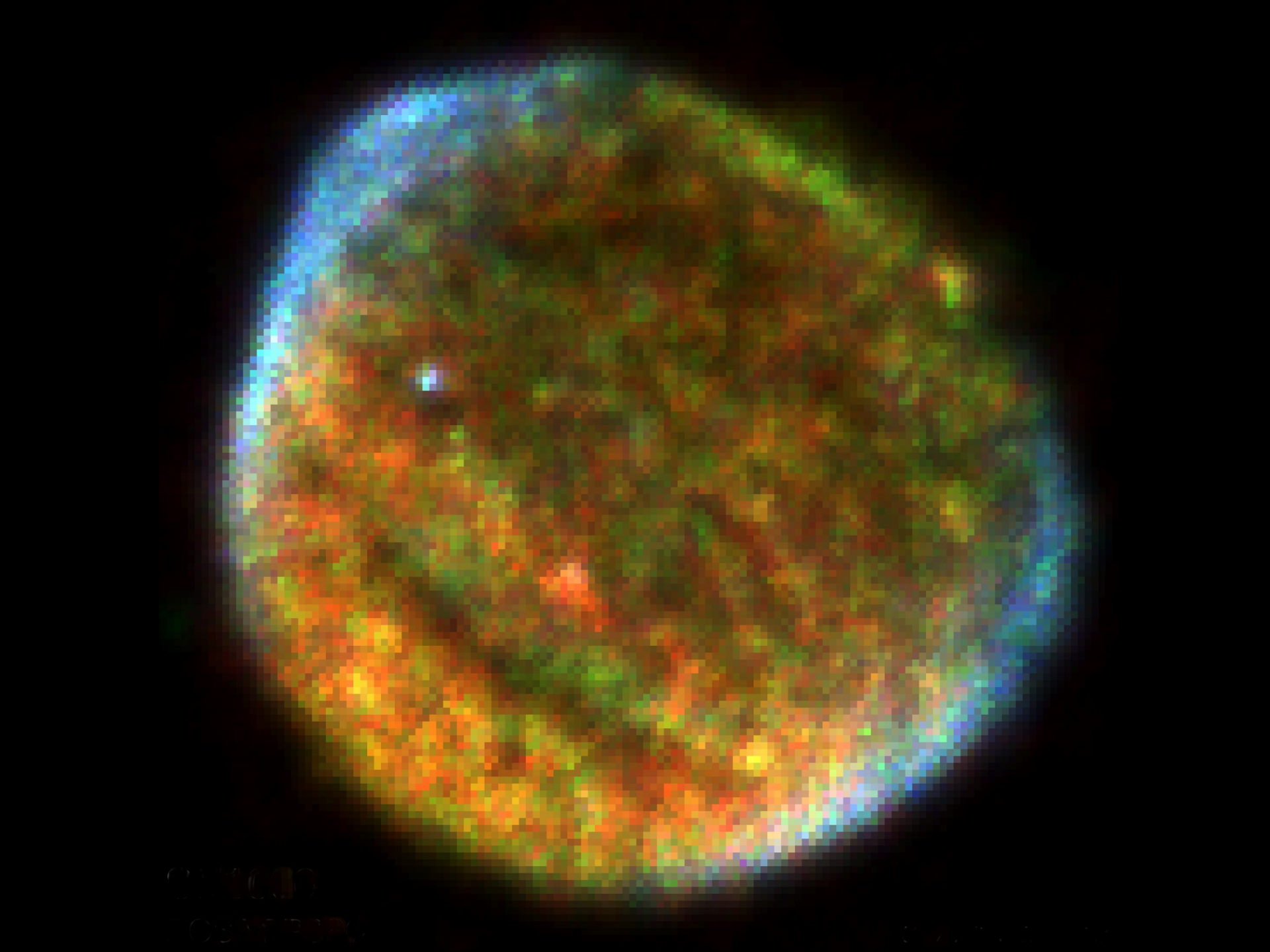


SN 1006

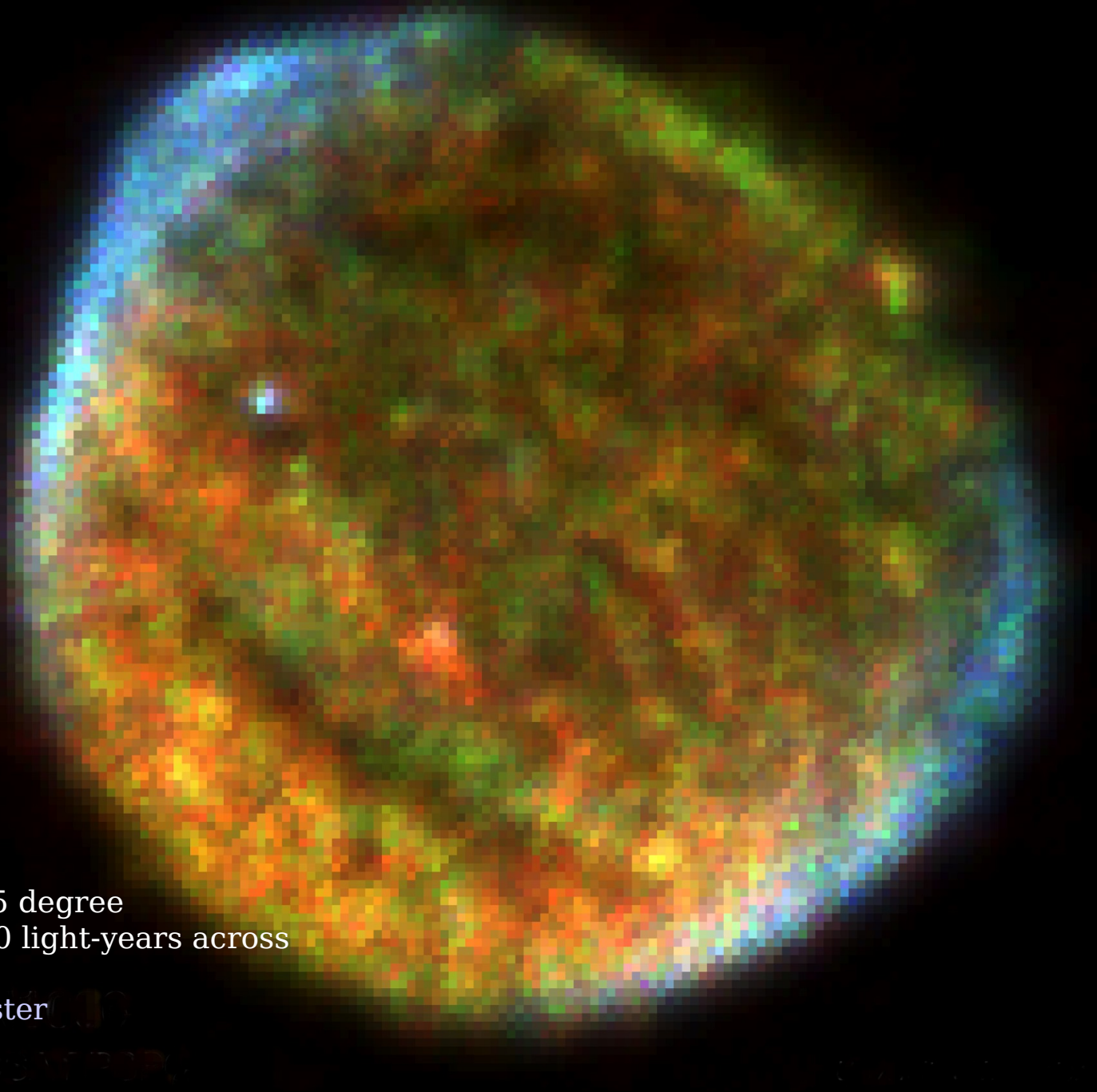


The supernova that produced the remnant SN 1006, perhaps the brightest in recorded history, was noted by scholars in Europe, Africa and the near and far East in A.D. 1006 in the constellation Lupus. The overlapping X-ray snapshots here, seen in false color, reveal the bright rims of the exploded star's still-expanding blast wave. Combined with spectra, this observation was a breakthrough in our understanding of the acceleration of cosmic rays in SNR s locks.

Field: angular diameter, 0.5 degree
Distance: 1.7-3.1 kpc, 3,500 light-years across
Instrument: ASCA
Credit: E. Gotthelf, NASA/GSFC

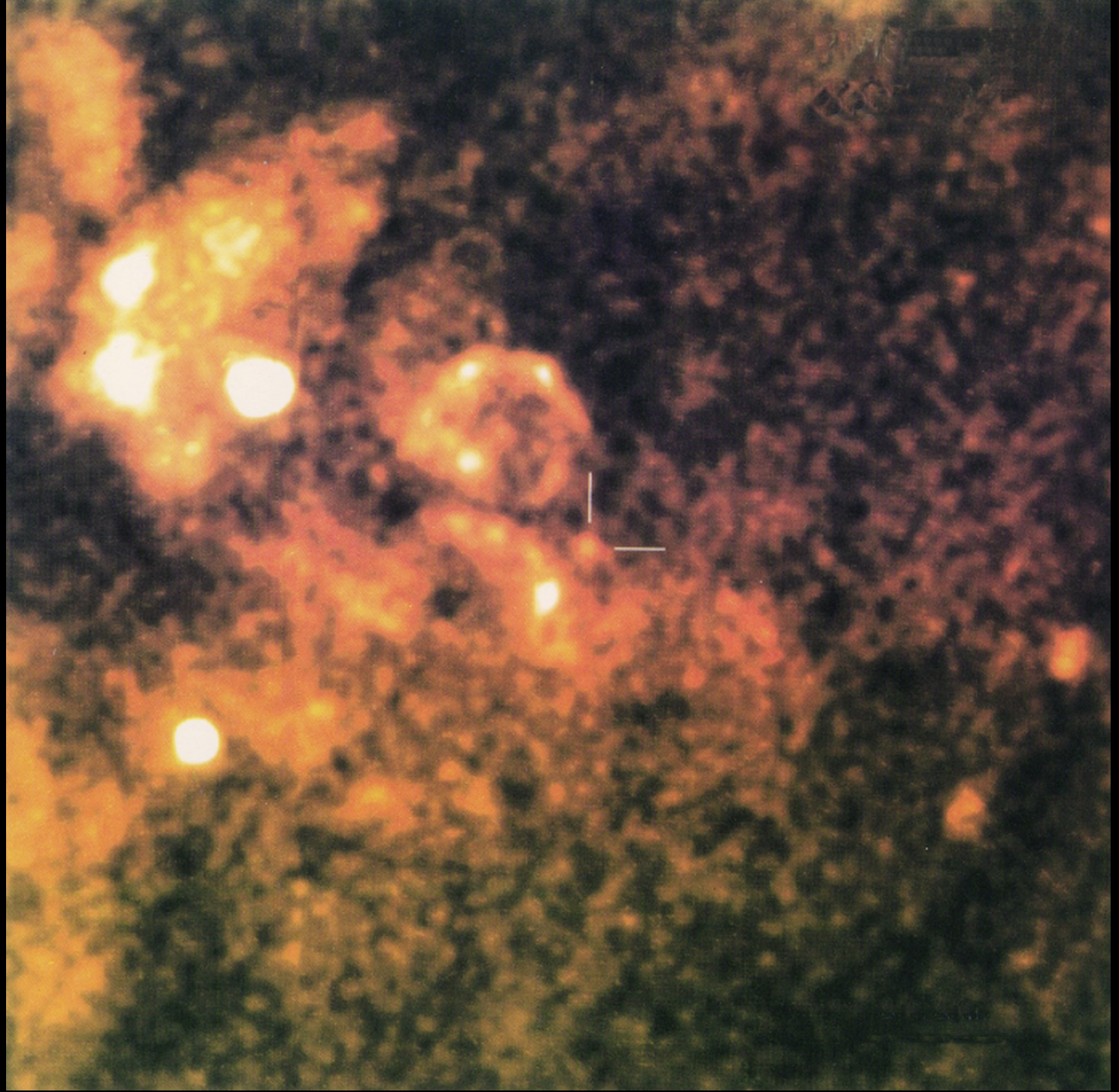


SN 1006

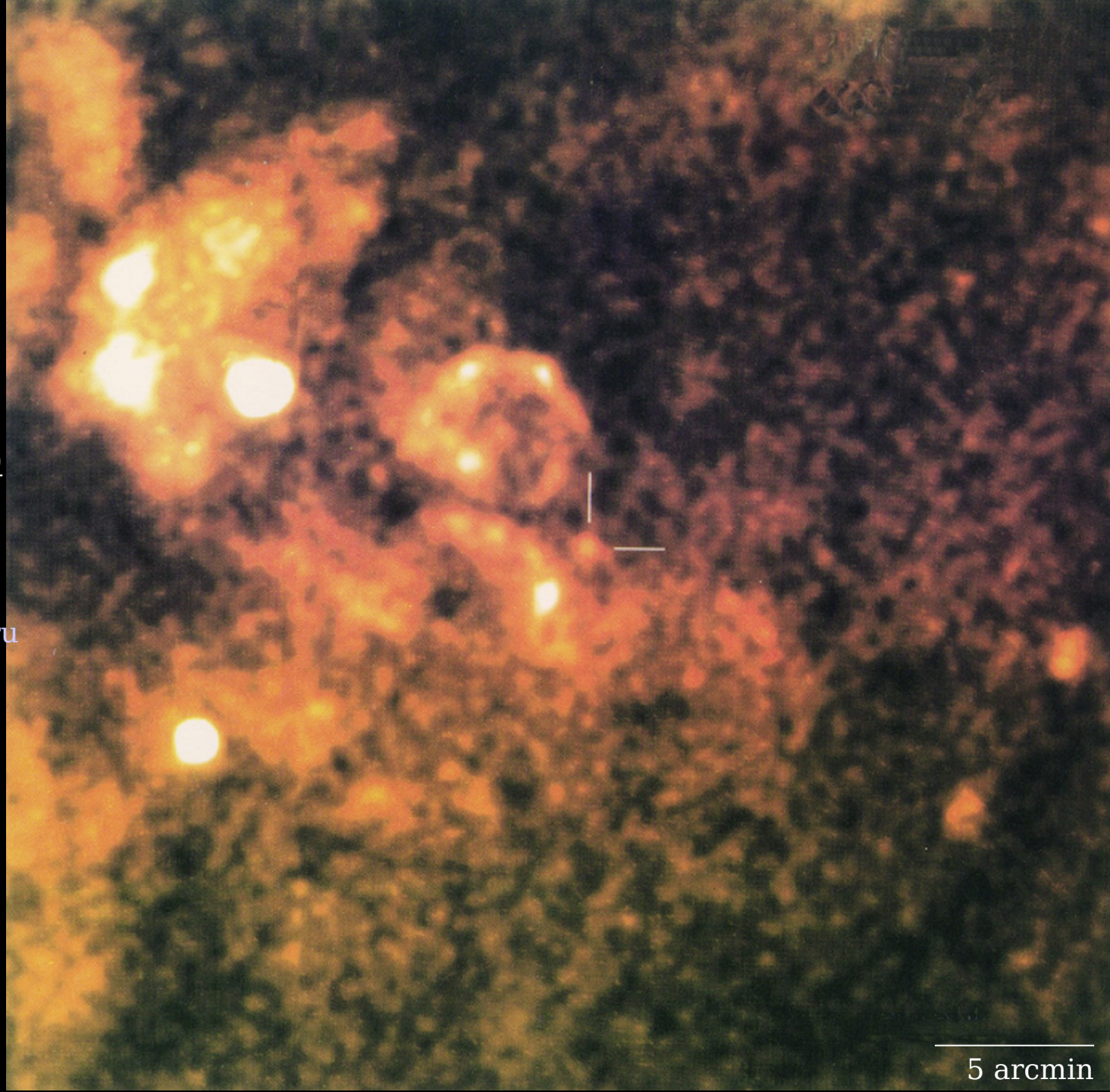


The supernova that produced the remnant SN 1006, perhaps the brightest in recorded history, was noted by scholars in Europe, Africa and the near and far East in A.D. 1006 in the constellation Lupus. This image shows both X-ray surface brightness and X-ray hardness/softness in color, an overlay of maps in three separate X-ray wavelengths. Combined with spectra, this observation was a breakthrough in our understanding of the acceleration of cosmic rays in SNR shocks

Field: angular diameter, 0.5 degree
Distance: 1.7-3.1 kpc, 3,500 light-years across
Instrument: ROSAT PSPC
Credit: University of Leicester

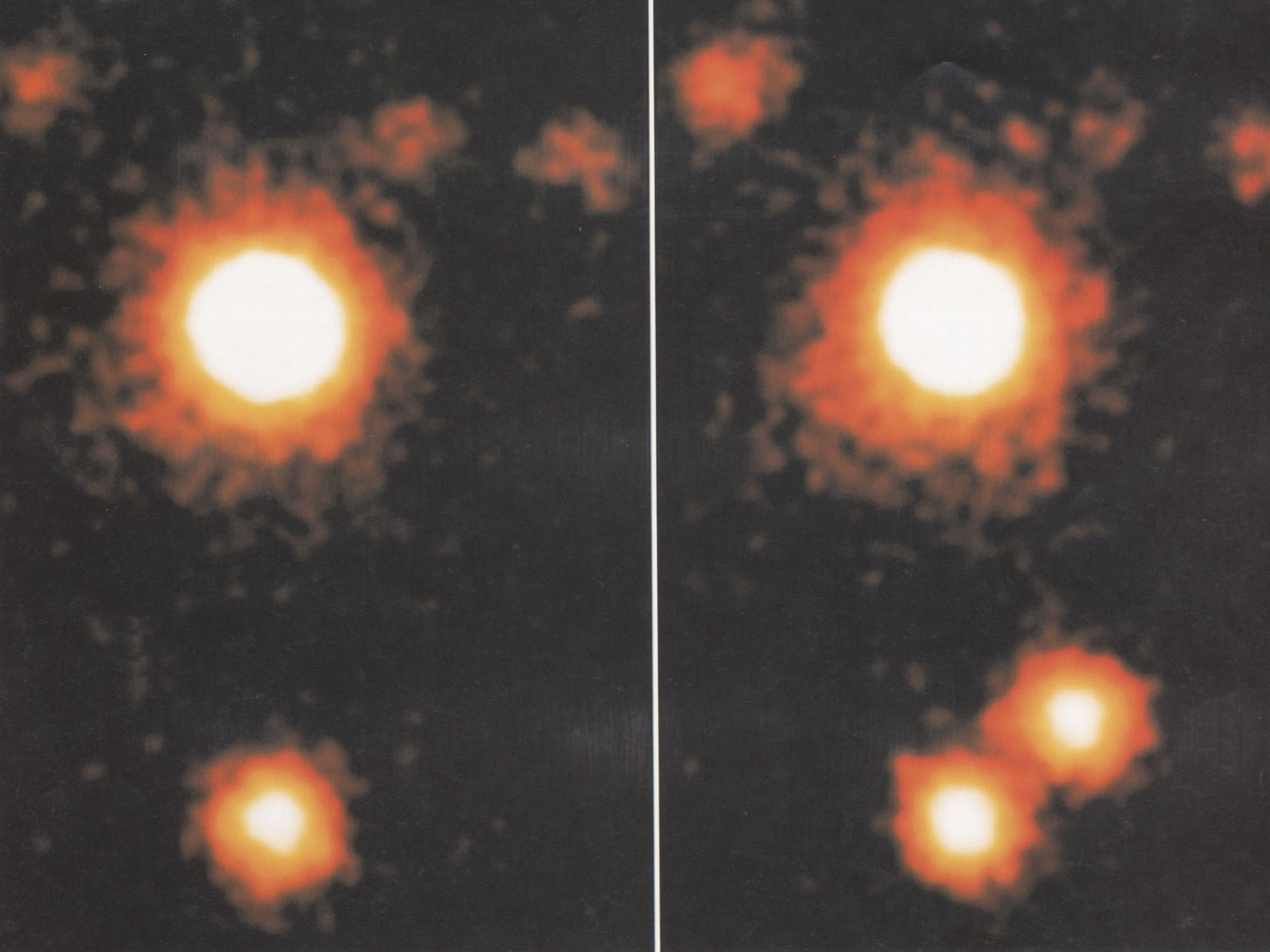


SN 1987a

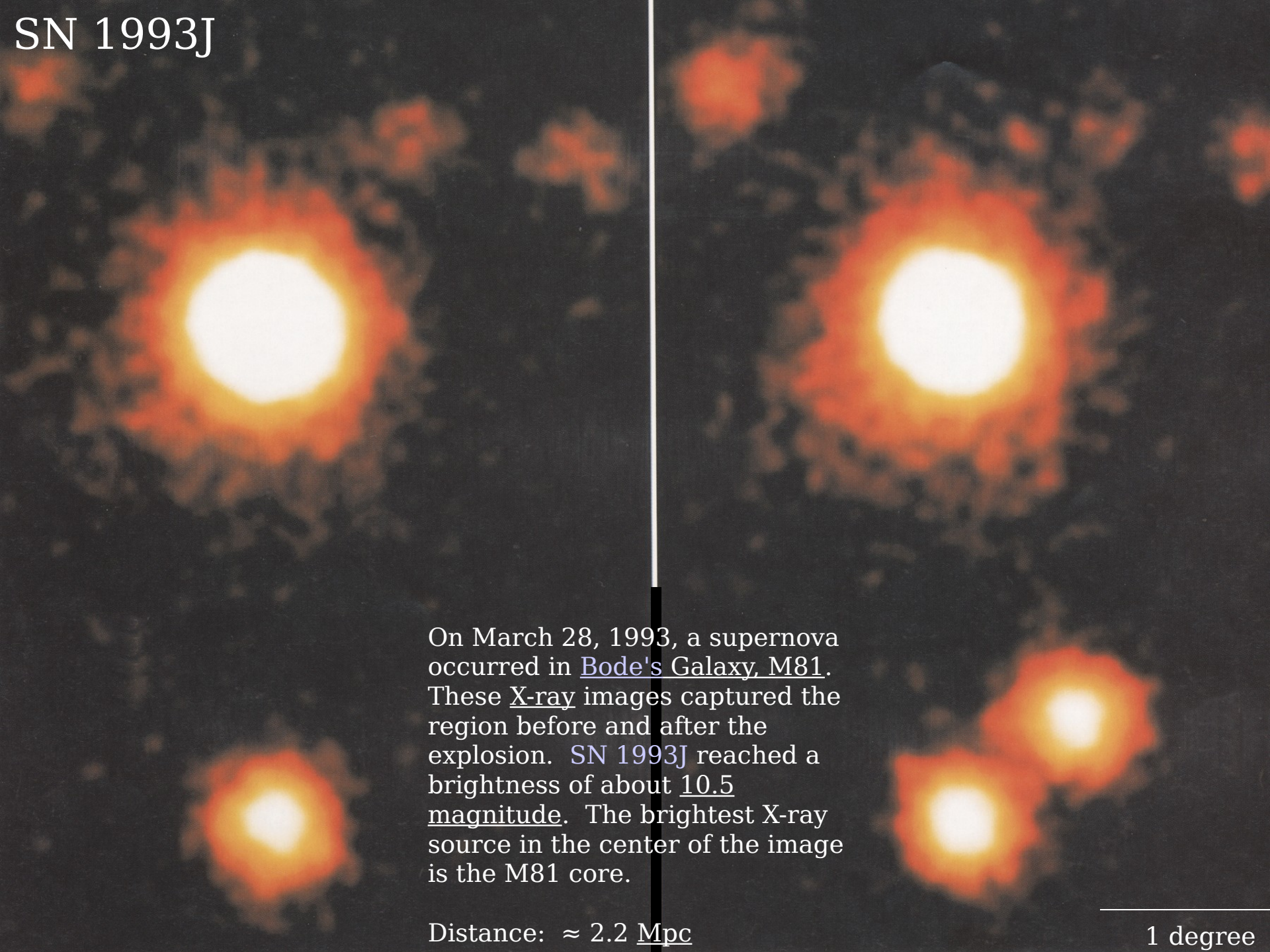


The star Sanduleak -69 202 in the Large Magellanic Cloud exploded around 169,000 years ago, reaching earth on February 23, 1987. This image shows SN 1987a in X-ray energy, marked by the cross-hairs near the diffuse structure of the Tarantula nebula and the ring-like structure of supernova N157C.

Distance: 52 kpc
Instrument:



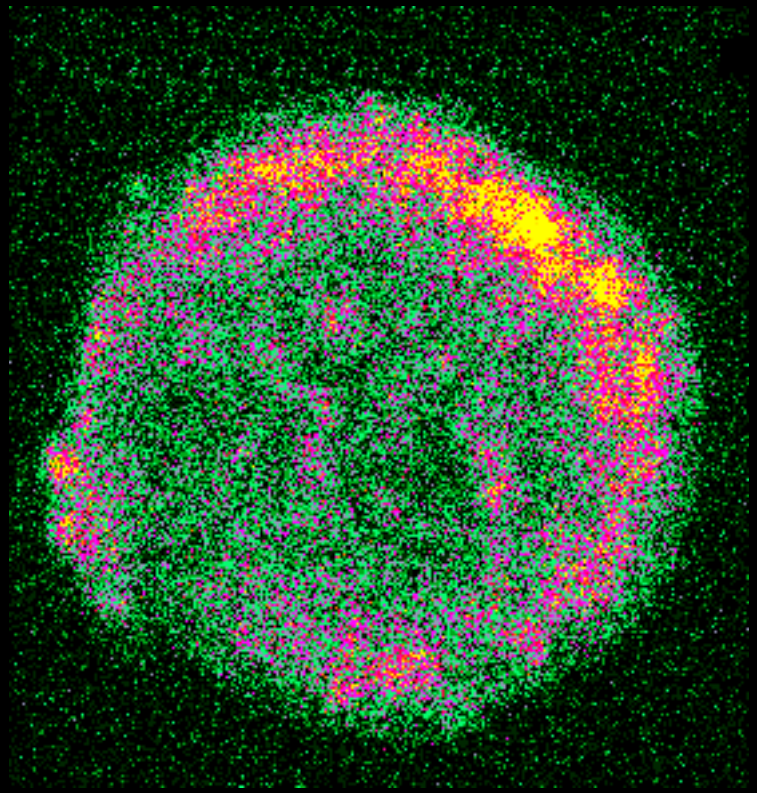
SN 1993J



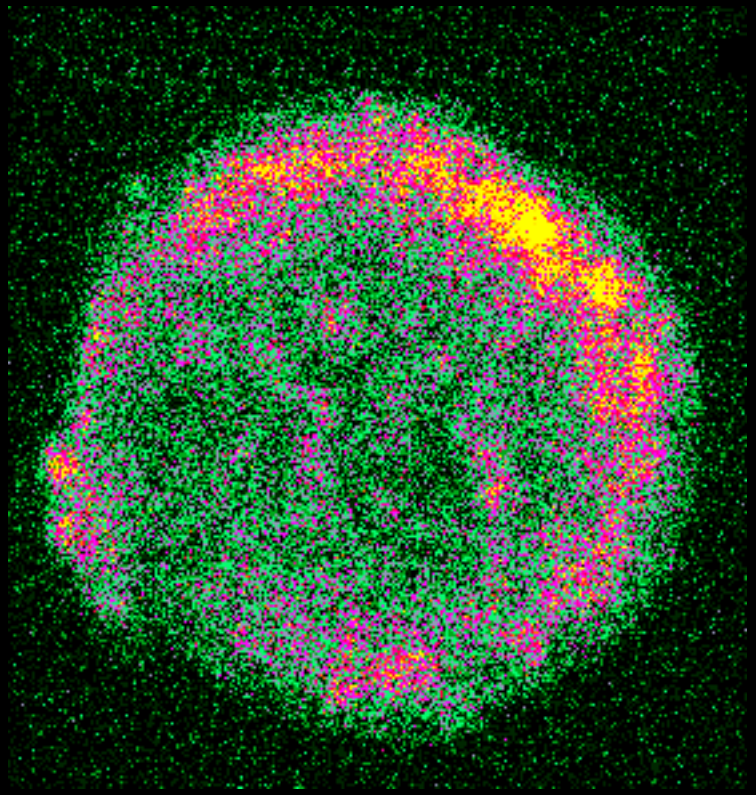
On March 28, 1993, a supernova occurred in Bode's Galaxy, M81. These X-ray images captured the region before and after the explosion. SN 1993J reached a brightness of about 10.5 magnitude. The brightest X-ray source in the center of the image is the M81 core.

Distance: ≈ 2.2 Mpc

1 degree



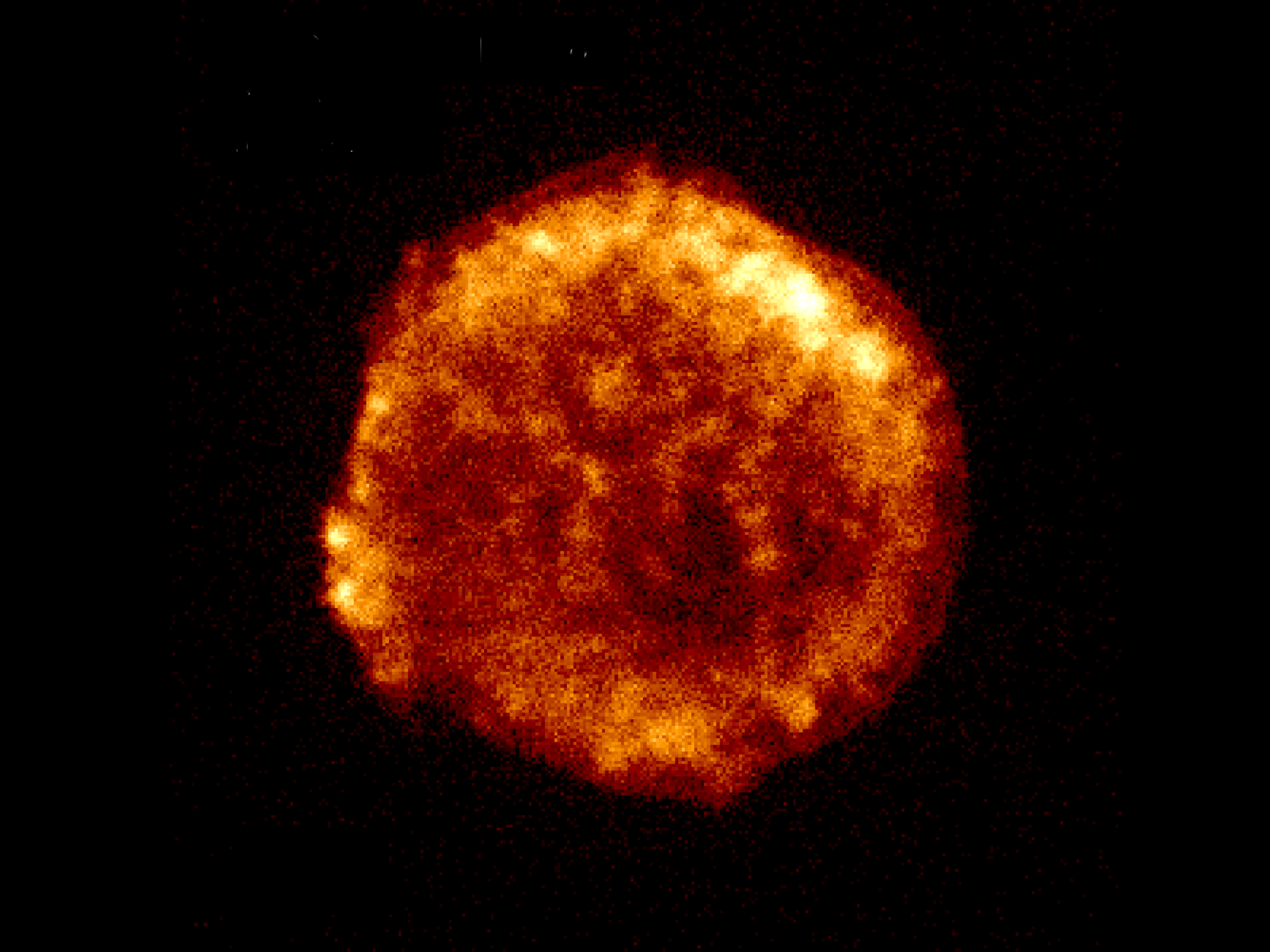
Tycho SNR 1572



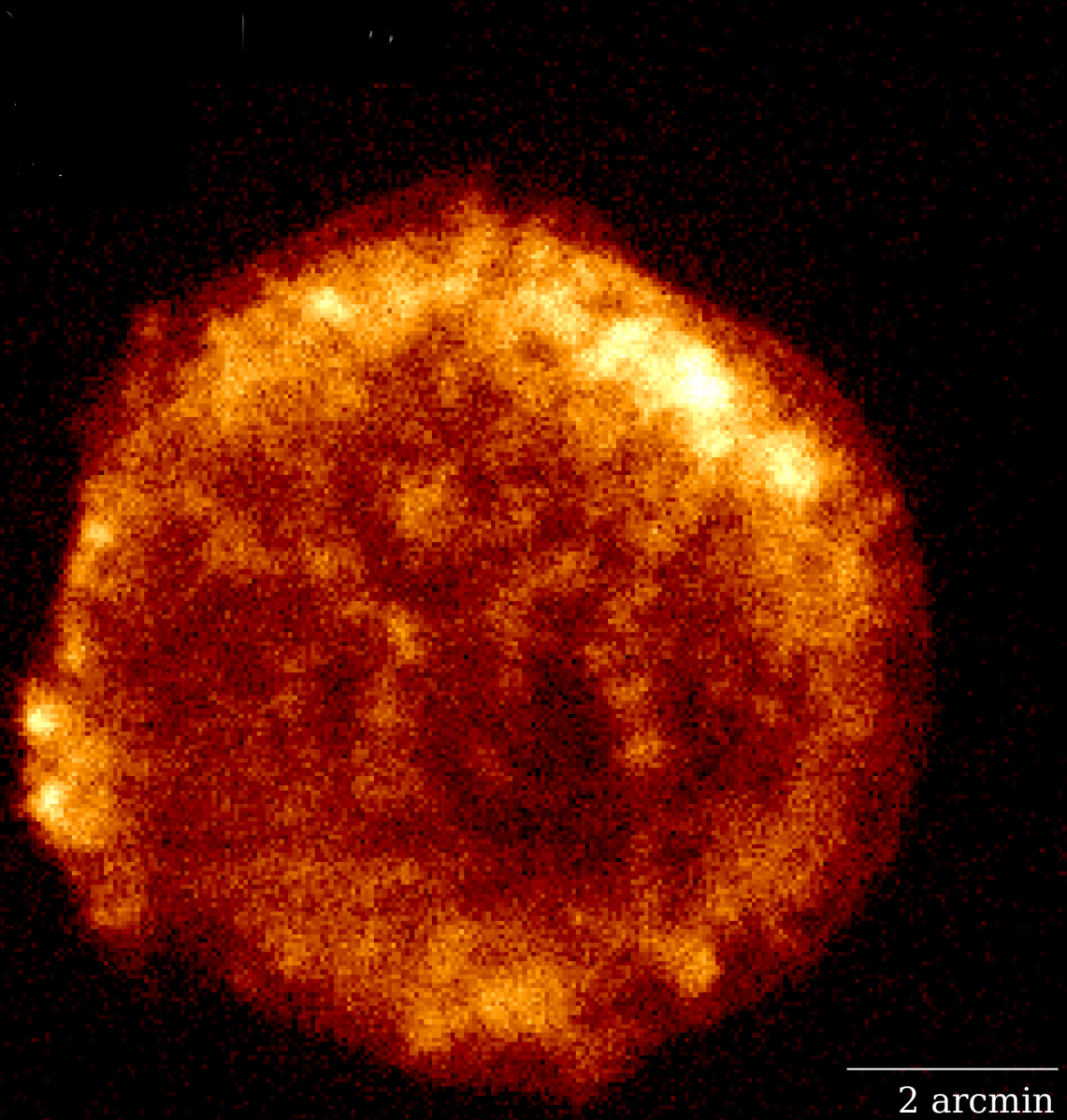
2 arcmin

On November 11, 1572, the Danish astronomer Tycho Brahe noted the presence of an extra star in the constellation of Cassiopeia, reaching an estimated -4 apparent magnitude. Today, in X-ray energy, we observe SNR Tycho, or SNR 1572, as an expanding shell of ejecta running into the interstellar environment at about Mach 150 and heating up to millions of degrees.

Distance: 2.3 - 5 kpc
Instrument:
Einstein (HEAO 2)
Credit: NASA

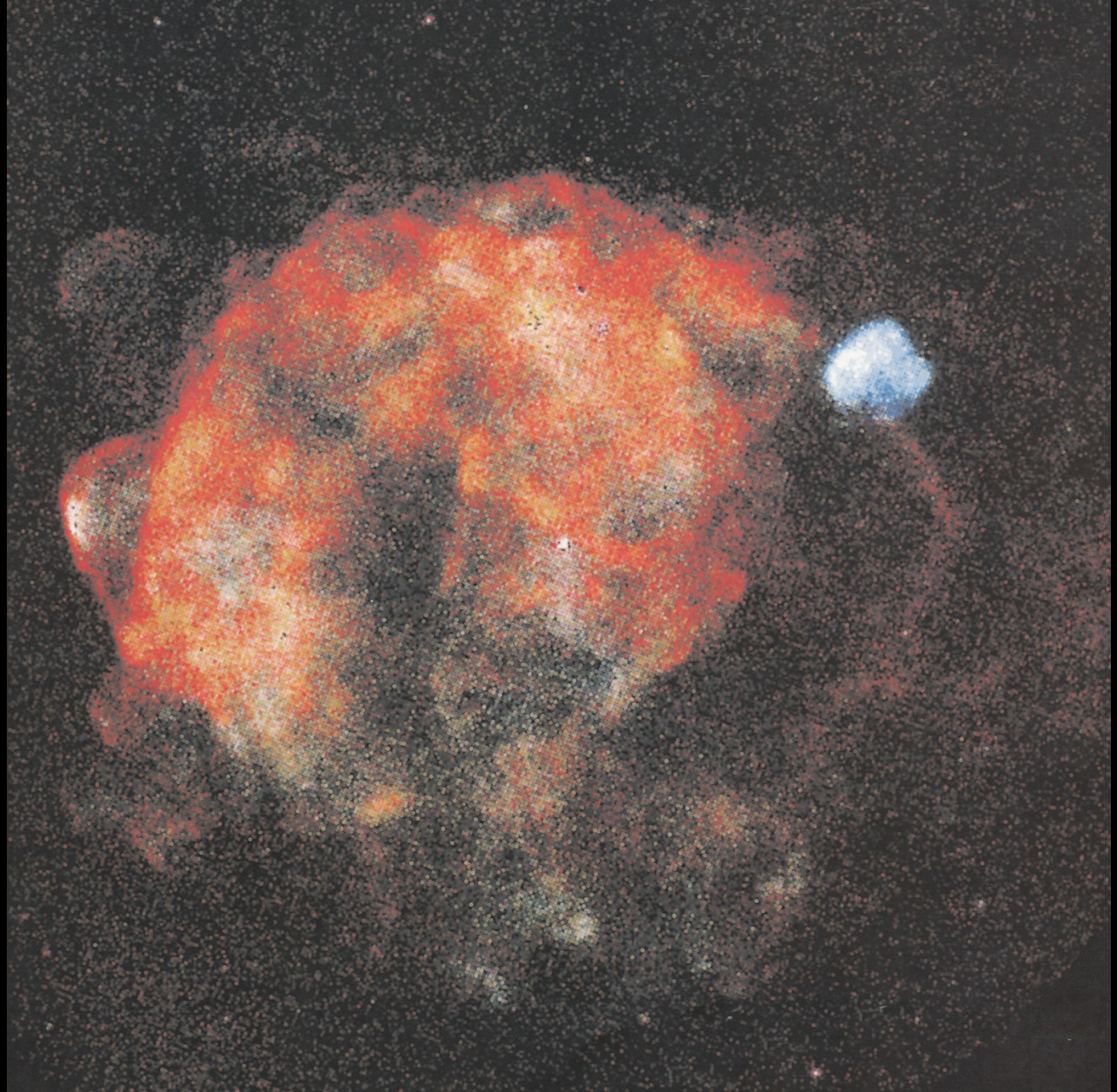


Tycho SNR 1572



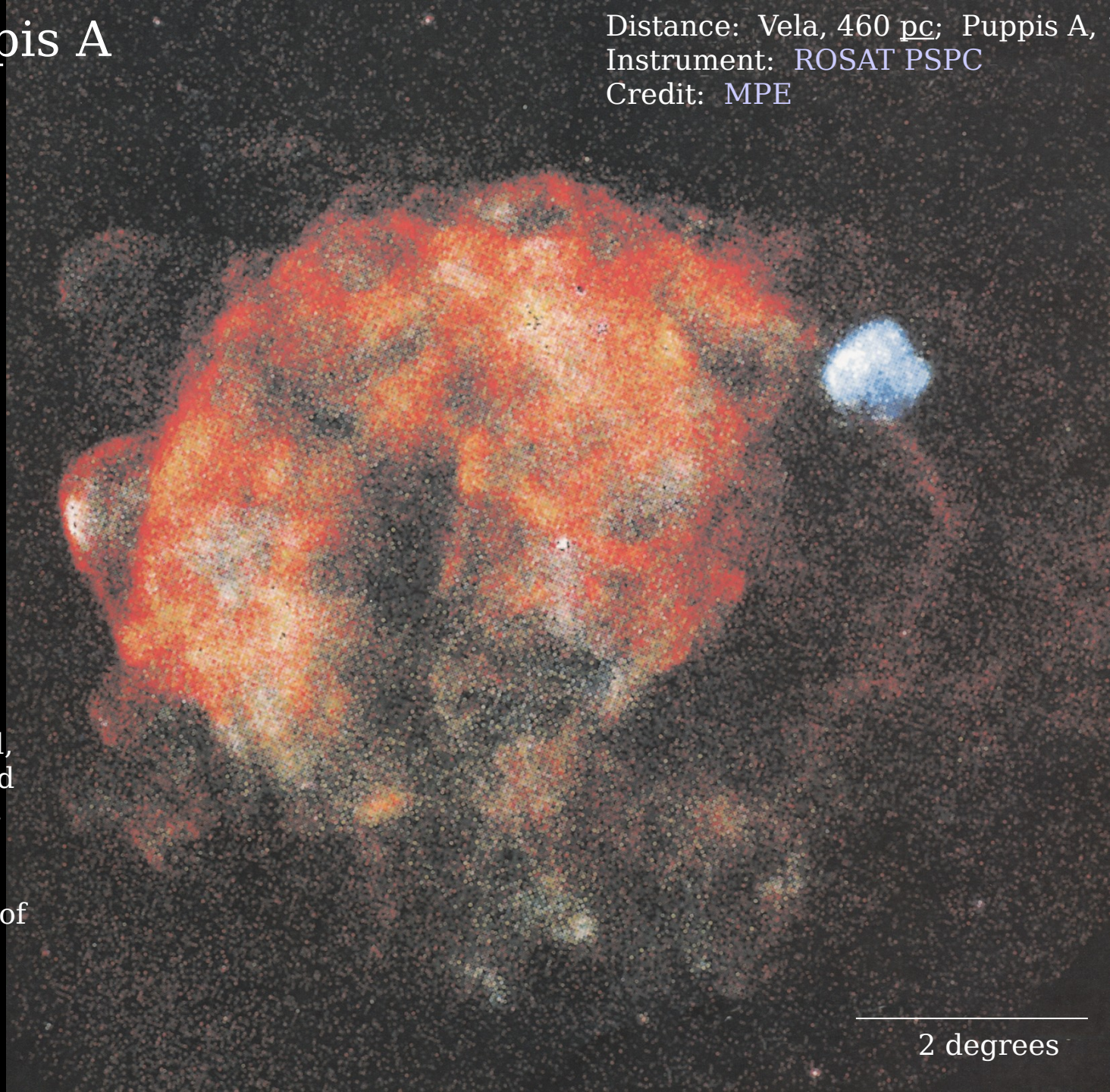
On November 11, 1572, the Danish astronomer Tycho Brahe noted the presence of an extra star in the constellation of Cassiopeia, reaching an estimated -4 apparent magnitude. Here in X-ray energy 0.1-2.0 keV, we observe SNR Tycho, or SNR 1572, as an expanding shell of ejecta running into the interstellar environment at about Mach 150 and heating up to millions of degrees.

Distance: 2.3 - 5 kpc
Instrument: ROSAT HRI
Credit: S.L. Snowden,

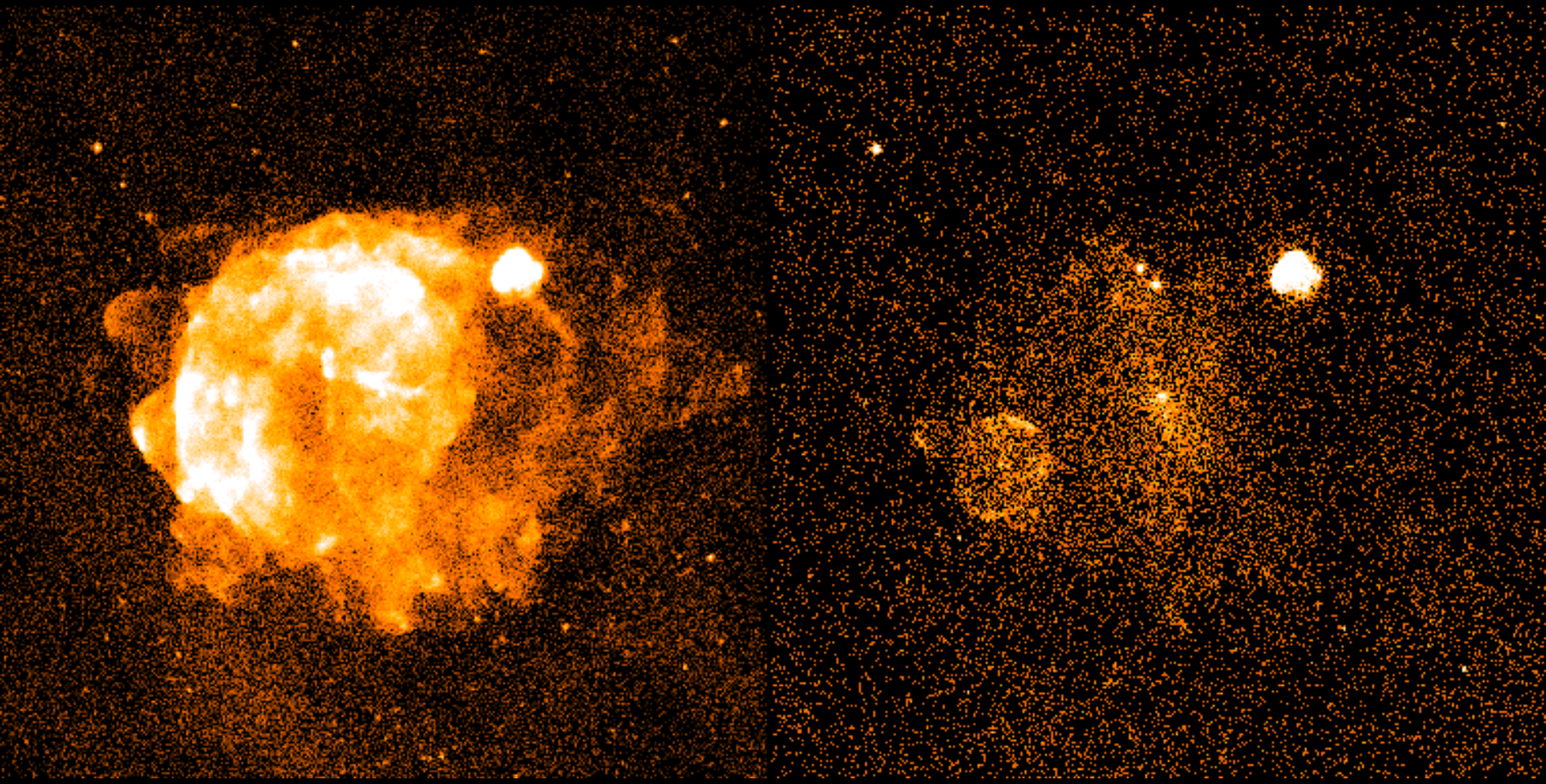


Vela and Puppis A

Distance: Vela, 460 pc; Puppis A,
Instrument: ROSAT PSPC
Credit: MPE

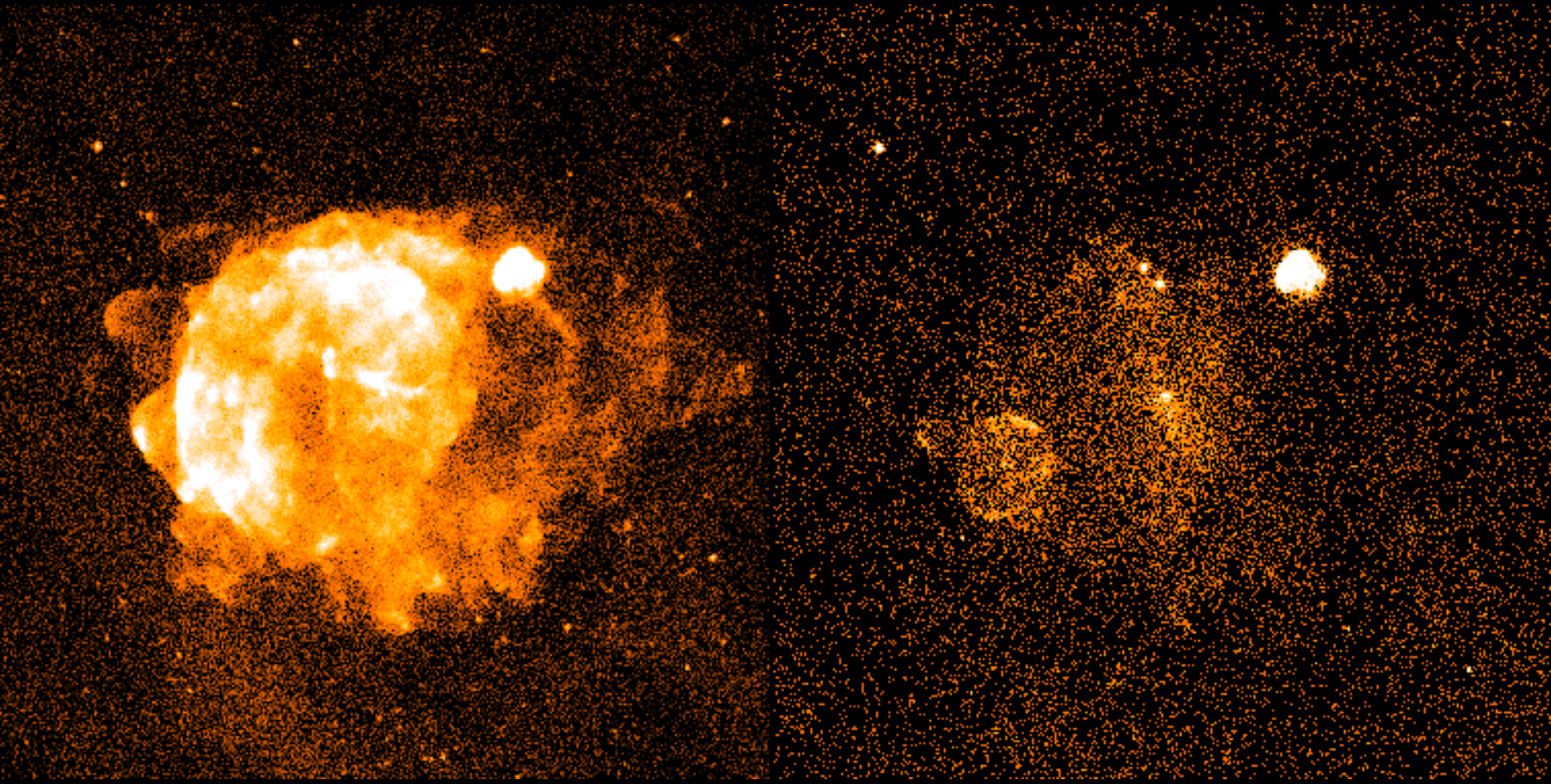


Two supernova remnants are seen in this X-ray image: the larger Vela, which covers most of the field, and Puppis A, enhanced in blue. Vela, 230 light years across, is one of the most extensively studied SNRs because of its large angular size and high surface brightness. Hidden behind the lower left corner of Vela is

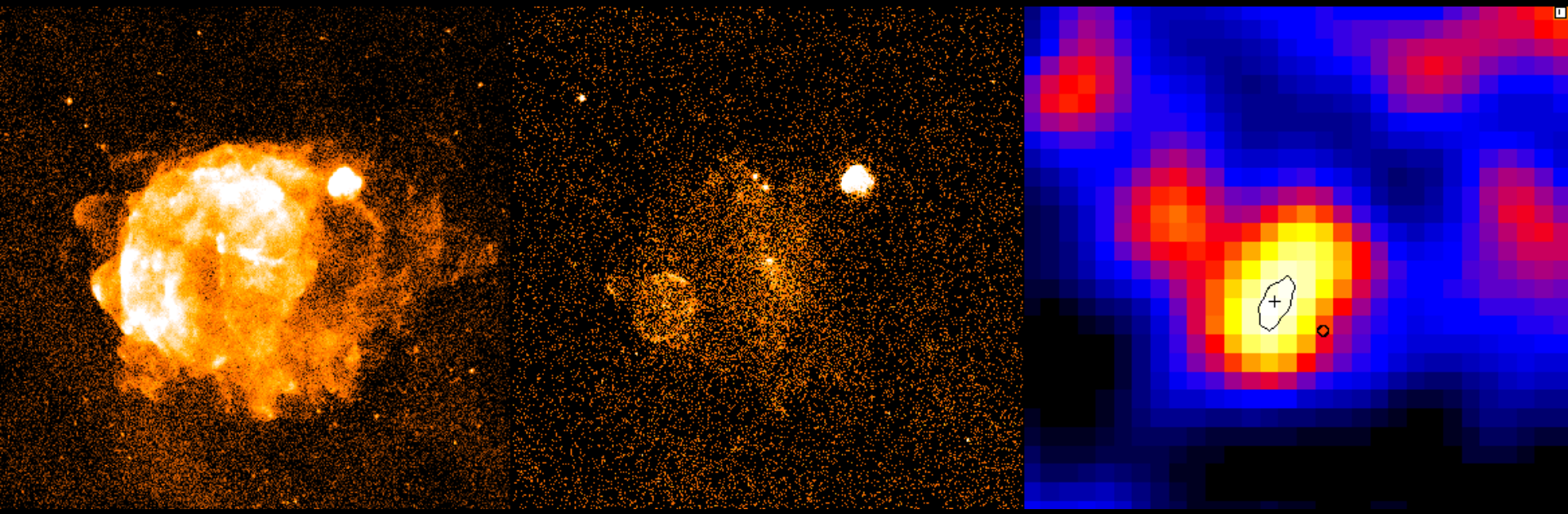


Young, Newly Uncovered SNR

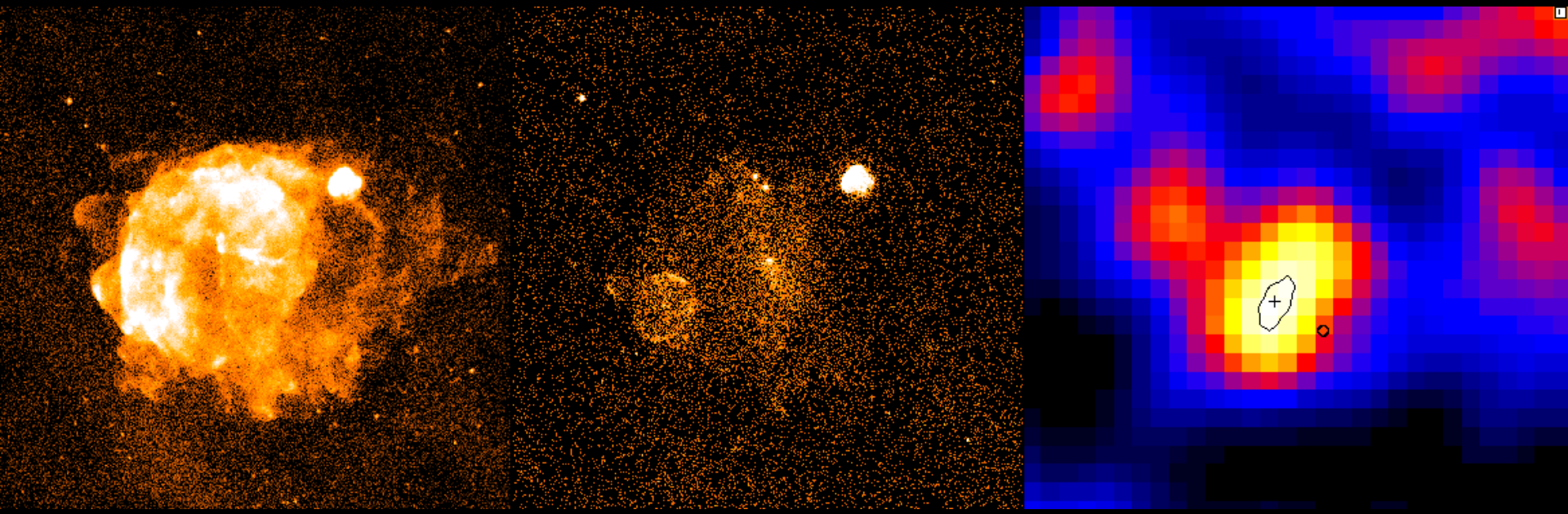
Distance: 200 pc
Instrument: ROSAT PSP
Credit: B. Aschenbach,



These two X-ray images uncover a new supernova remnant hiding behind Vela. The first image (0.1-2.4 keV) isolates Vela, which covers most of the field, and Puppis A, the smaller ball in the upper right. In the second image (E > 1.3 keV), we begin to see the newest supernova remnant. The corresponding supernova exploded 680 years ago and must have outshone everything in the night sky except the moon.
So, why wasn't the event recorded by earlier astronomers?

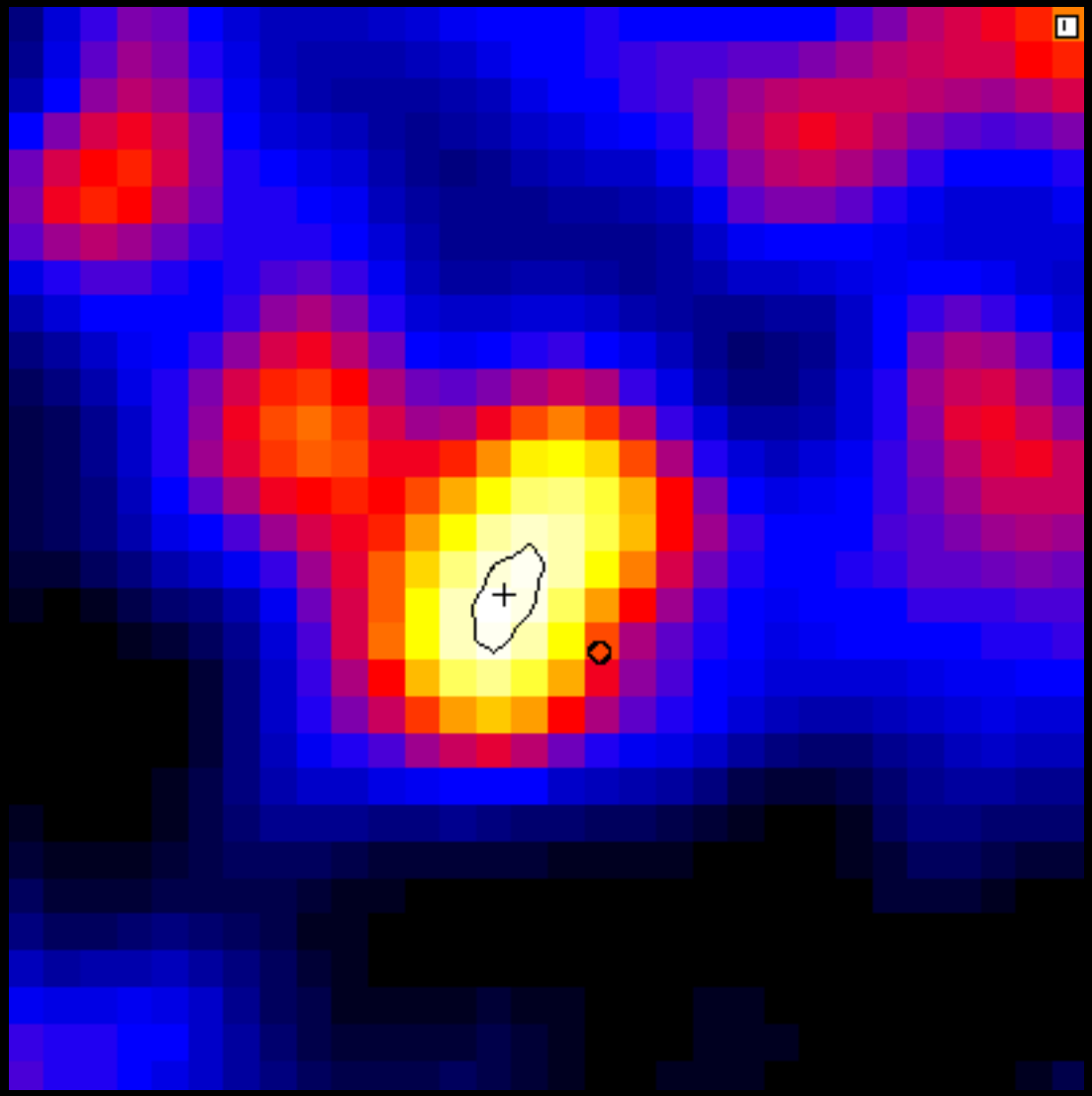


Young, Newly Uncovered SNR

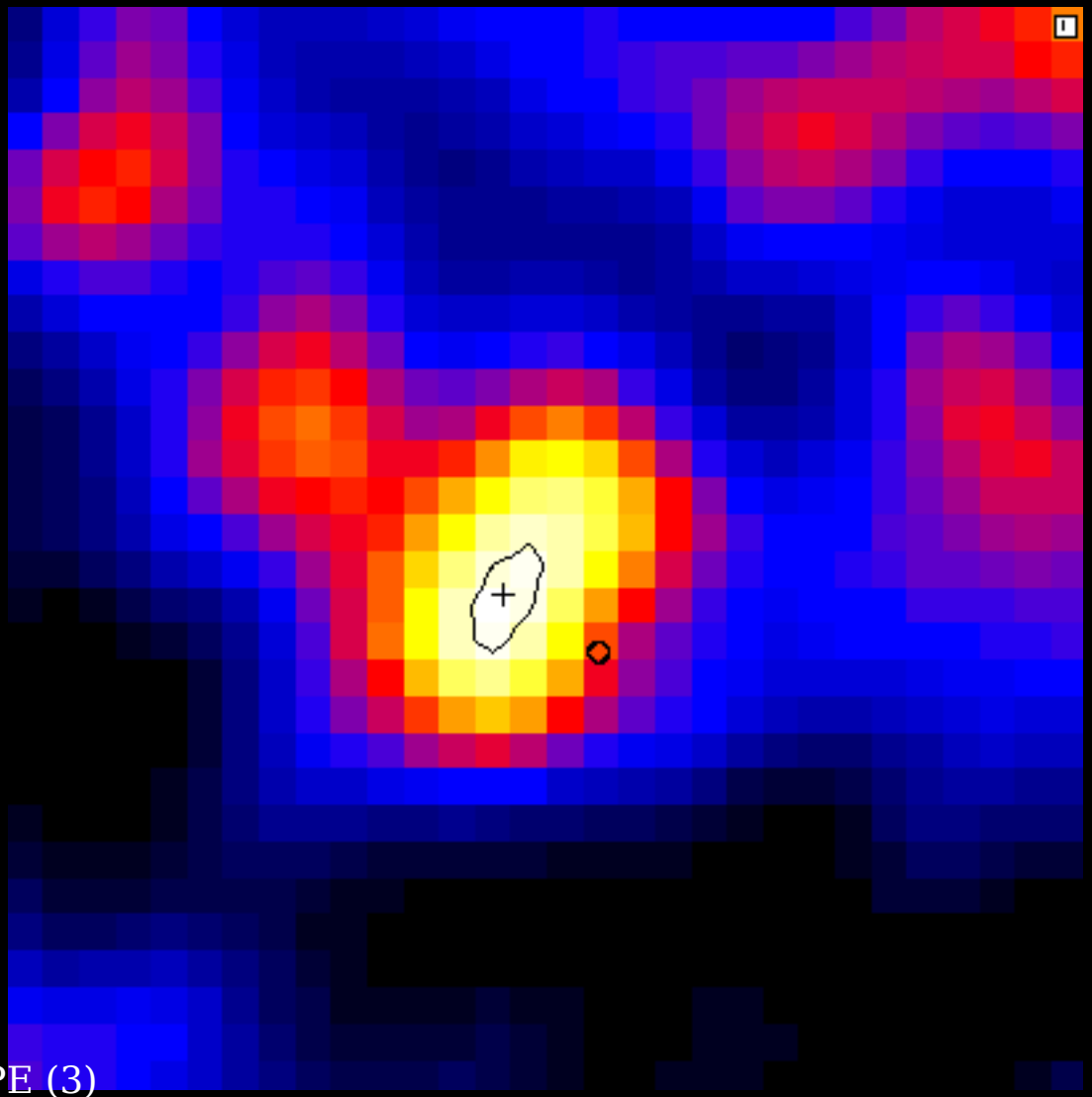


Left to right, these two X-ray images and a gamma-ray image uncover a new supernova remnant hiding behind Vela. The first image (0.1-2.4 keV) isolates Vela, which covers most of the field, and Puppis A, the smaller ball in the upper right. In the second image (E > 1.3 keV), we begin to see the newest supernova remnant. The gamma-ray likelihood map (1.16 MeV) looks only at the decay of ^{44}Ti, which has a half-life of 90 years. Vela and Puppis A have long since used up their radioactive titanium, and are therefore invisible in this range of gamma rays.

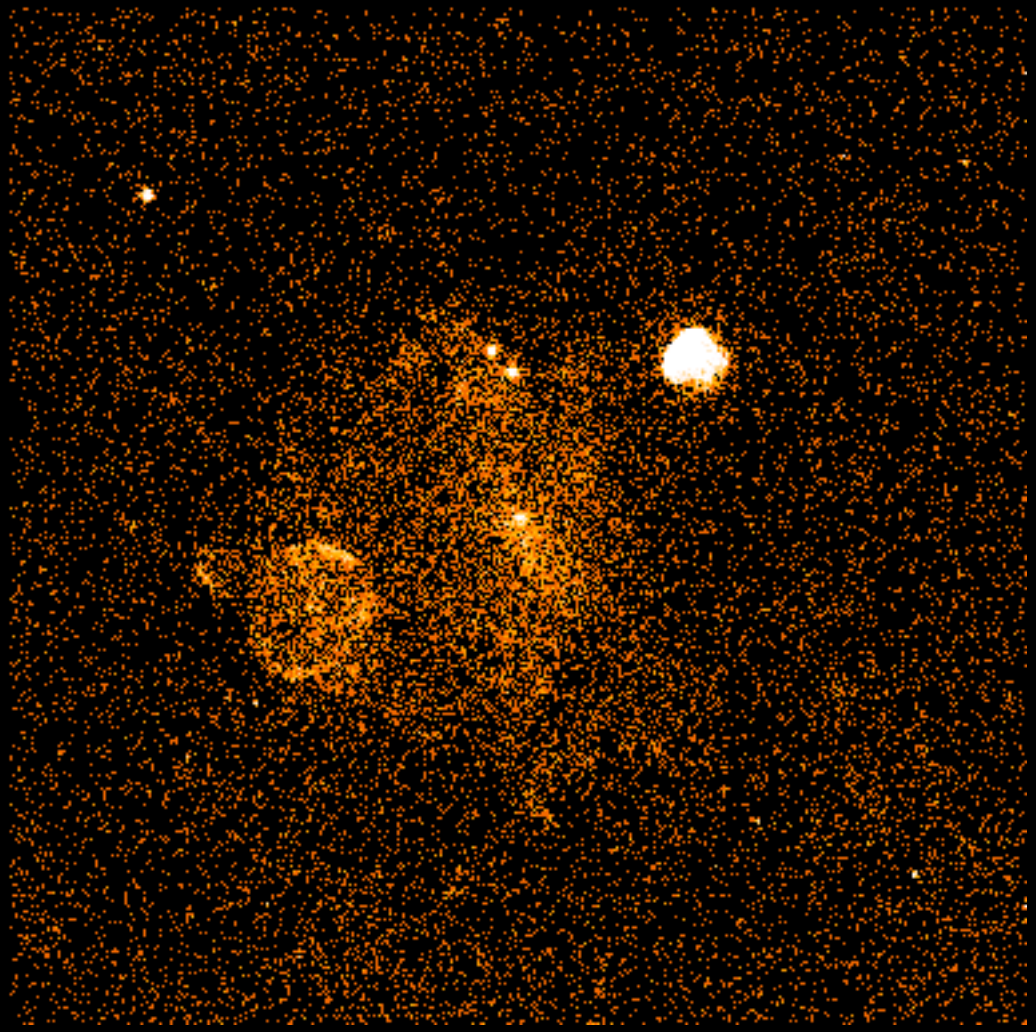
Distance: 200 pc to new SNR
Instrument: ROSAT PSPC (1,2); CGRO COMPTEL (3)
Credit: B. Aschenbach, MPE (1,2); A. Lyudin & V. Schondelfer, MPE (3)



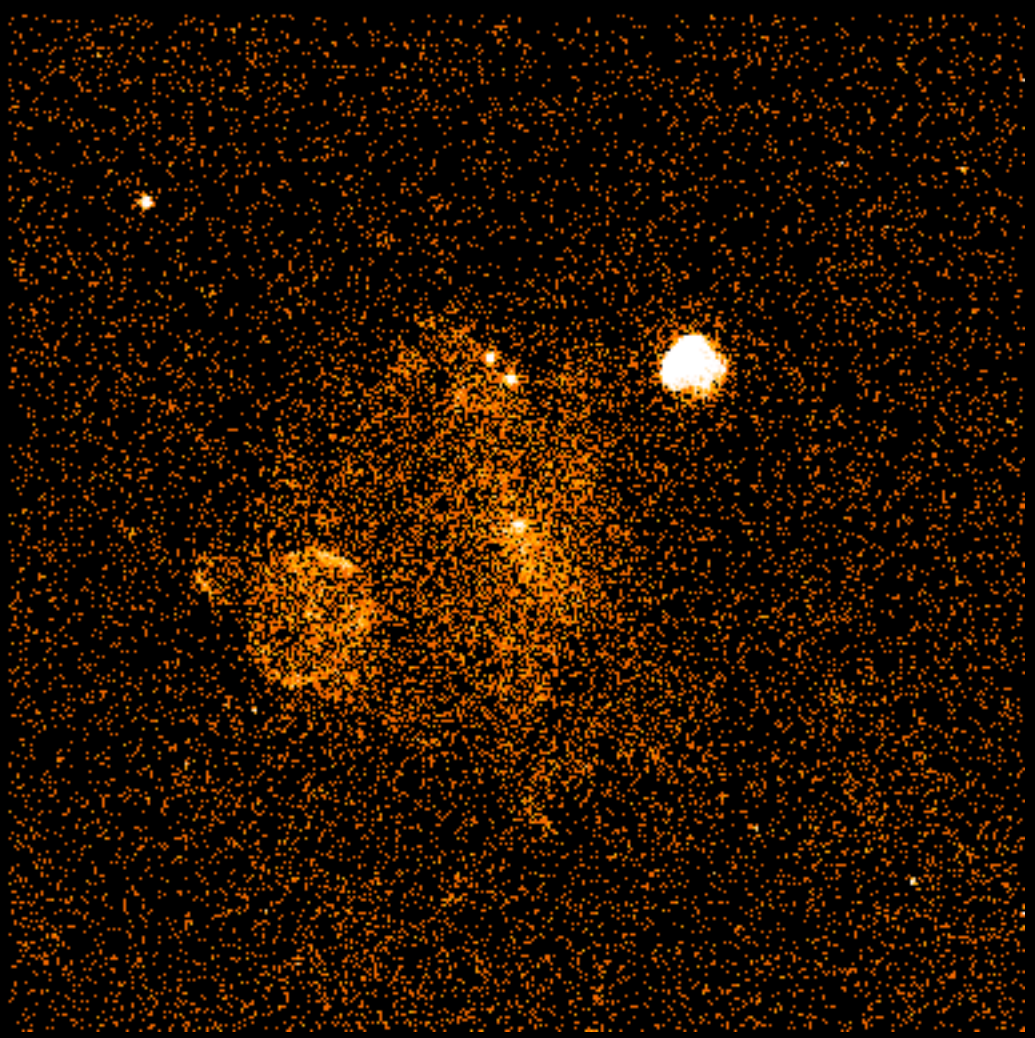
Young, Newly Uncovered SNR



This gamma-ray likelihood map (1.16 MeV) from the decay of ^{44}Ti reveals a young supernova remnant that was hiding behind the Vela supernvova remnant. ^{44}Ti has a half-life of 90 years, so Vela, having long since used up its radioactive titanium, is invisible in this range of gamma ray. The supernova itself exploded 680 years ago and must have outshone everything in the night sky except the moon.
So, why wasn't the eventrecorded by earlier astronomers?
Distance: 200 pc
Instrument: CGRO COMPTEL
Credit: A. Lyudin & V. Schondelfer, MPE (3)



Young, Newly Uncovered SNR



A young supernova remnant was hiding behind Vela. A first look at the region (0.1-2.4 keV) revealed the massive Vela, which covers most of the field, and Puppis A, the smaller ball in the upper right. In this X-ray image (E > 1.3 keV), we begin to see the newest supernova remnant. The corresponding supernova exploded 680 years ago and must have outshone everything in the night sky except the moon. So, why wasn't the eventrecorded by earlier astronomers?

2 degree

Distance: 200 pc
Instrument: ROSAT PSP
Credit: B. Aschenbach,